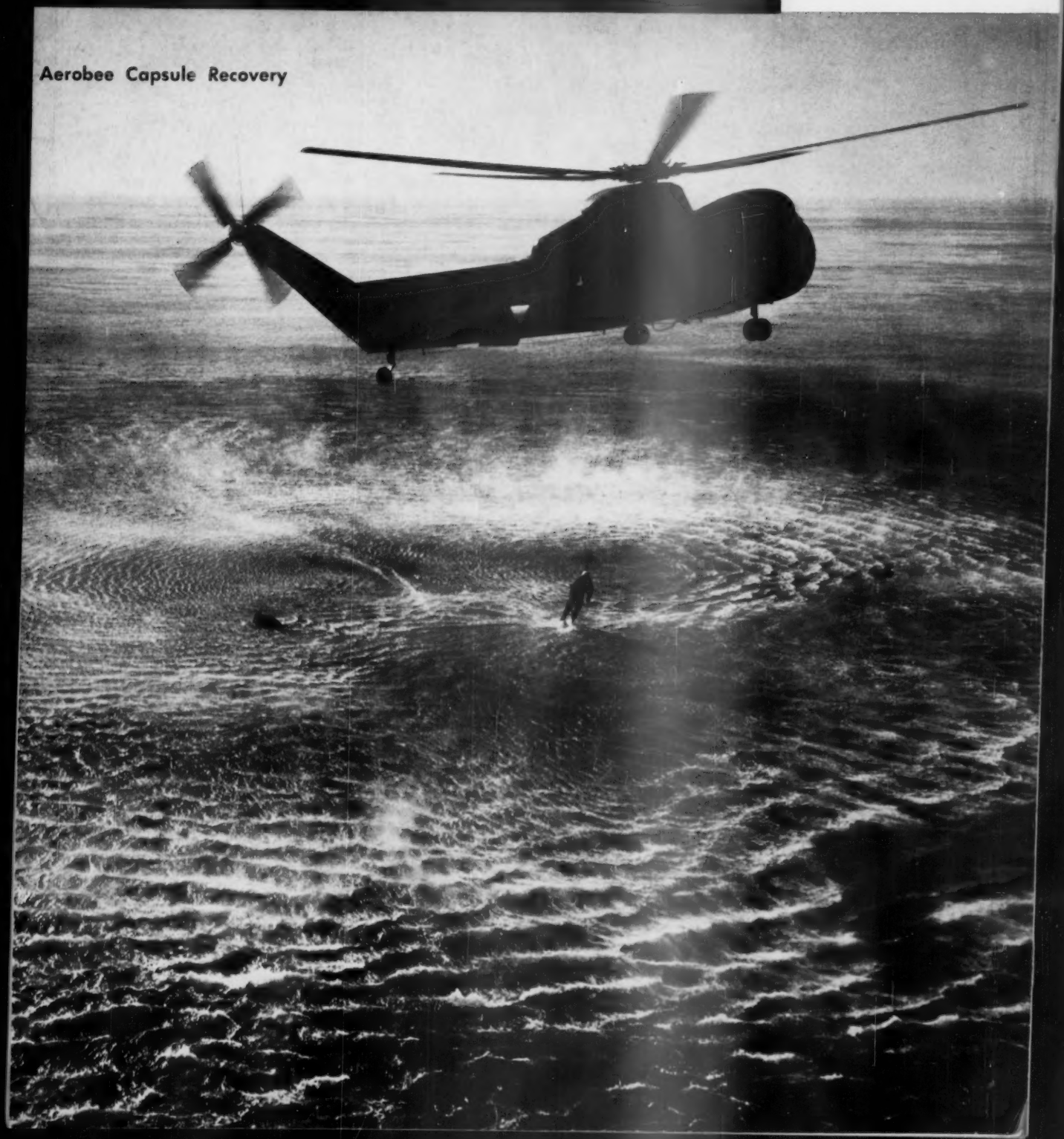
Aviation Week and Space Technology

June 12, 1961

Mariner to Scan Venus' Surface

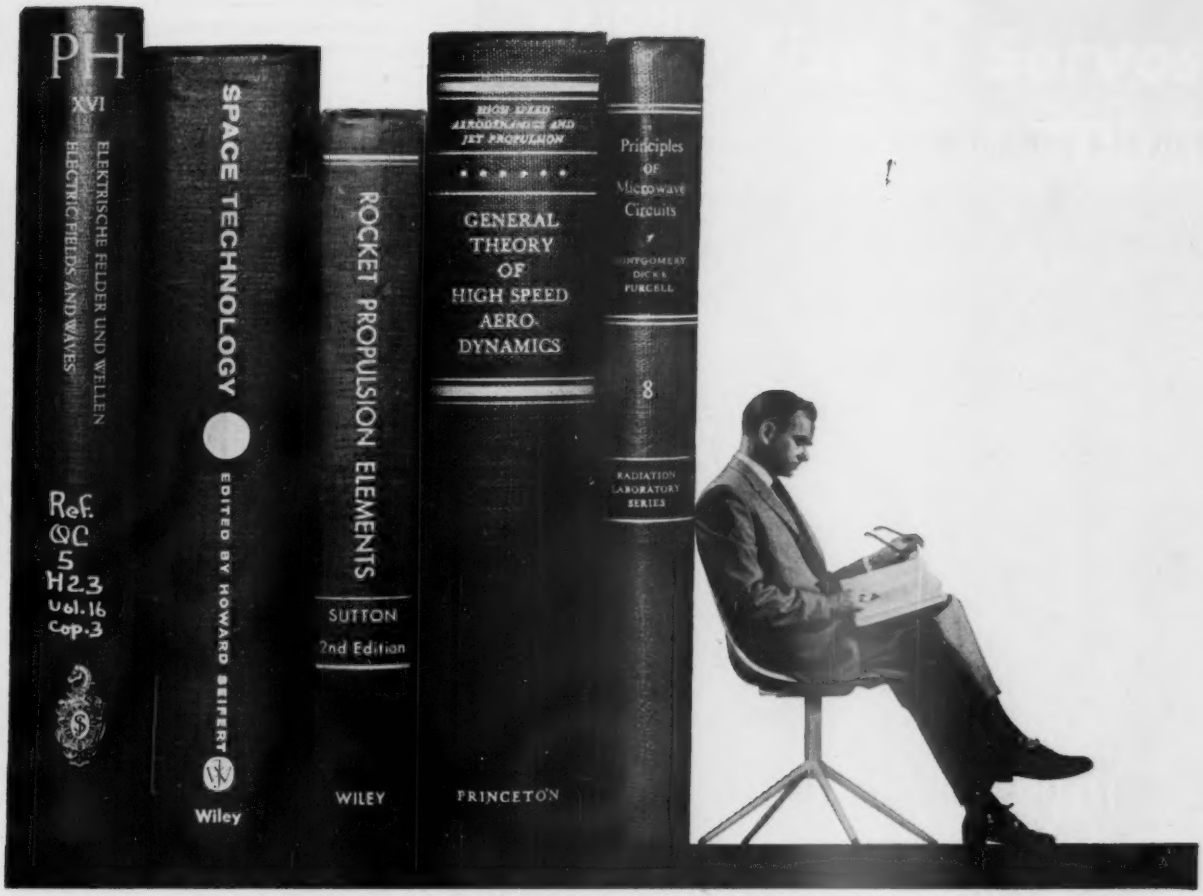
•

Price Pinch Hits Semiconductors



Aerobee Capsule Recovery

Engineers, scientists — investigate outstanding opportunities at Aerojet



scientists and engineers in a unique leadership role

The frontiers of space science and technology are being expanded at Aerospace Corporation. The scientists and engineers of this leadership organization are the critical civilian link uniting government and the scientific-industrial team developing space systems and advanced ballistic missiles. In providing broad scientific and technical leadership to every element of this team, they are engaged in a balanced program of activities spanning the spectrum from basic research and forward planning through general systems engineering. Included in the latter are technical supervision, integration and review of the engineering, development and test operations of industry to the extent necessary to assure achievement of system concept and objectives in an economical and timely manner. These people are privileged to view both the state-of-the-art and system development in their totality. Now more men of superior ability are needed: highly motivated scientists and engineers with demonstrated achievement, maturity, and judgment, beyond the norm. Such men are urged to contact Aerospace Corporation, Room 101, P. O. Box 95081, Los Angeles 45, California.

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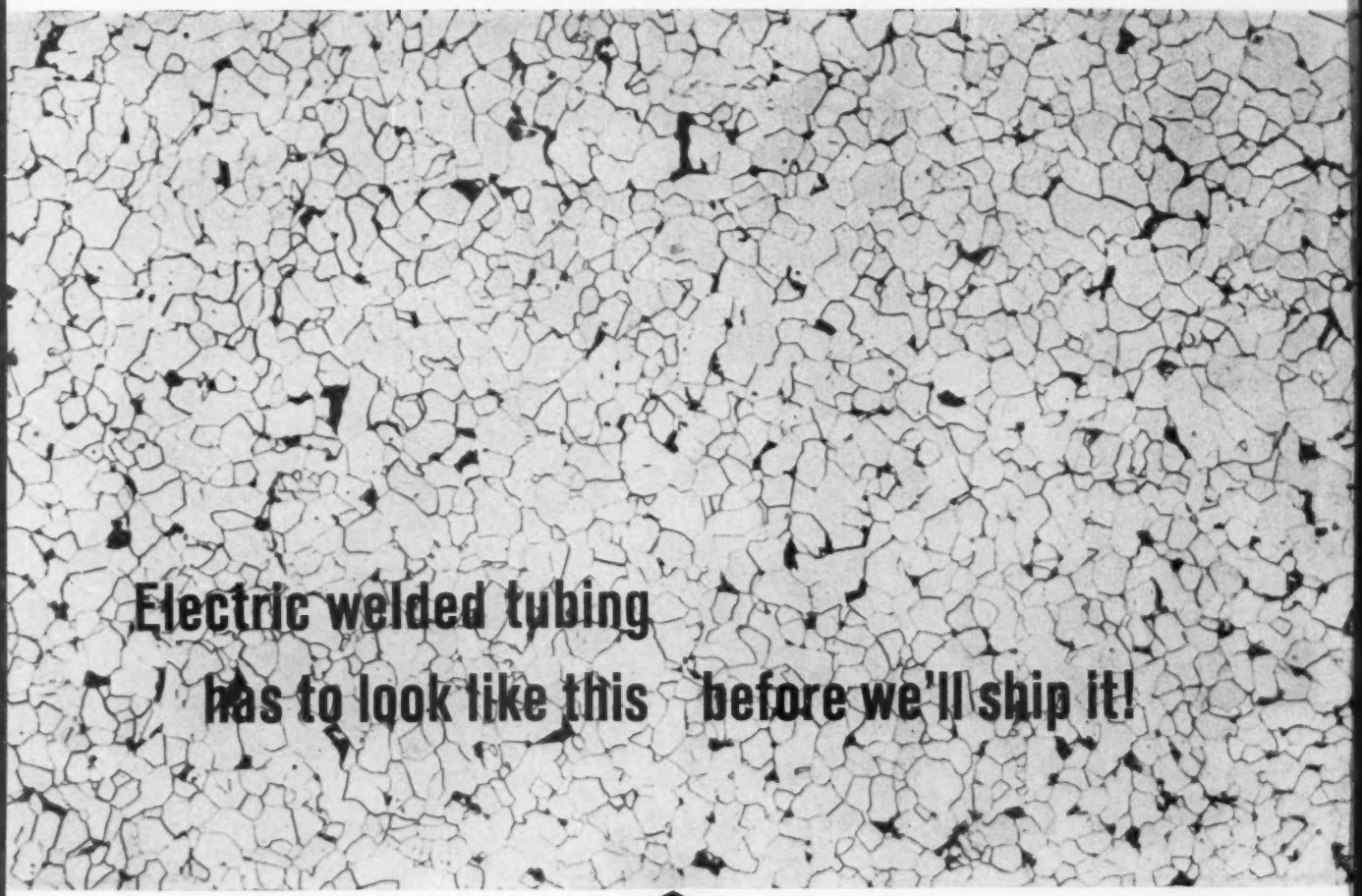

In this photomicrograph of a section of USS National Electric Resistance Welded Steel Mechanical Tubing the weld section runs right down through the center of the picture above the arrow. The consistency of structure between the weld area and the rest of the tube shows that USS National Welded Mechanical Tubing has an important attribute—dependability.

Mechanical tubing must be flawless. It's used in so many critical applications that demand utmost strength, excellent surface inside or outside and extreme dimensional accuracy. National Tube's production methods assure this high quality.

Important advantages of USS National Welded Mechanical Tubing are its ability to reduce machining operations to a minimum or eliminate them entirely. For a given weight, it withstands more load than any other section. It resists bending stresses equally in all directions. In torsion, it provides maximum material distribution.

USS National Welded Mechanical Tubing is available in cold-drawn or hot-rolled sizes ⅜″ thru 5½″ and in wall thickness .035″ to .250″. All sizes can be obtained from National Tube Distributors located throughout the country. They will gladly show how tubing can reduce your costs. *See your USS National Tube Distributor.* *USS and National are registered trademarks*

National Tube Division of United States Steel

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Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division • United States Steel Export Company, New York

AVIATION CALENDAR

June 19-21—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International Academy of Astronautics, Paris, France.

June 19-21—Supersonic Transport Guidance & Control Symposium, Western Hills Hotel, Ft. Worth, Tex. Sponsor: Western Region, Institute of Navigation.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 24-27—First Reunion of World War I Overseas Flyers, Air Force Museum, Wright-Patterson AFB, Dayton, Ohio.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-28—European Symposium on Space Technology, British Interplanetary Society, London, England.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 27-29—International Symposium on Analytical Astrodynamics, Santa Barbara, Calif. (Contact: Capt. J. L. Gilbert, Air Force Office of Scientific Research, Washington 25, D. C.)

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 8-12—15th Annual All-Woman Transcontinental Air Race, San Diego, Calif.-Atlantic City, N. J.

(Continued on page 6)

AVIATION WEEK and Space Technology

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Vol. 74, No. 24

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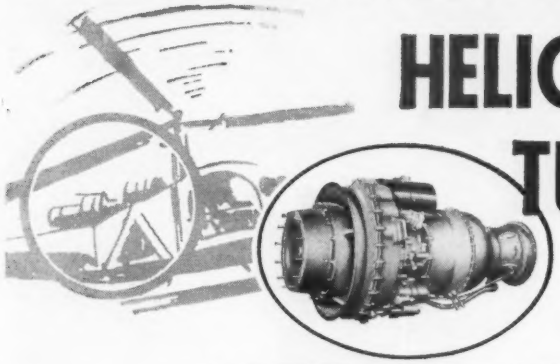

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AVIATION CALENDAR

(Continued from page 5)

July 13-16—Third Annual Industry Missile and Space Conference and Aerospace Exposition, Michigan Aeronautics and Space Assn., Cobo Hall, Detroit, Mich.

July 16-21—Fourth International Conference on Bio-Medical Electronics, Institute of Radio Engineers, Waldorf-Astoria, New York, N. Y.

July 17—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

July 20-21—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Grove Park Inn, Asheville, N. C.

July 24-26—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

July 31-Aug. 11—Conference on Physics of the Solar System and Re-entry Dynamics. For information write: Conference Director, Room 310, Holden Hall, Virginia Polytechnic Institute, Blacksburg, Va.

Aug. 1-3—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 7-9—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

Aug. 15-17—Cryogenic Engineering Conference, University of Michigan, Ann Arbor.

Aug. 16-18—International Hypersonics Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 19-24—Institute of the Aerospace Sciences/Naval Aviation Meeting, San Diego, Calif. (Classified.)

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Aug. 24-26—Sixth Annual National Reunion, OX5 Club of America, Allis Hotel, Wichita, Kan.

Aug. 30-Sept. 1—Third Annual Semiconductor Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, England. Wilbur Wright Memorial Lecture, Sept. 12.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Sept. 20-24—National Convention and Aerospace Panorama, Air Force Assn., Philadelphia, Pa.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

Oct. 14-22—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janiero, Brazil.

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RIGHT Here Hi-Loks are being installed in the A3J rear fuselage with Hi-Lok right angle tooling adapted to a Ratchet Wrench Motor. Other Hi-Lok adaptor tooling is available in straight, extended and offset styles to overcome difficult or tight clearance conditions resulting from the unusual structural configurations of high performance airframes such as the Vigilante.

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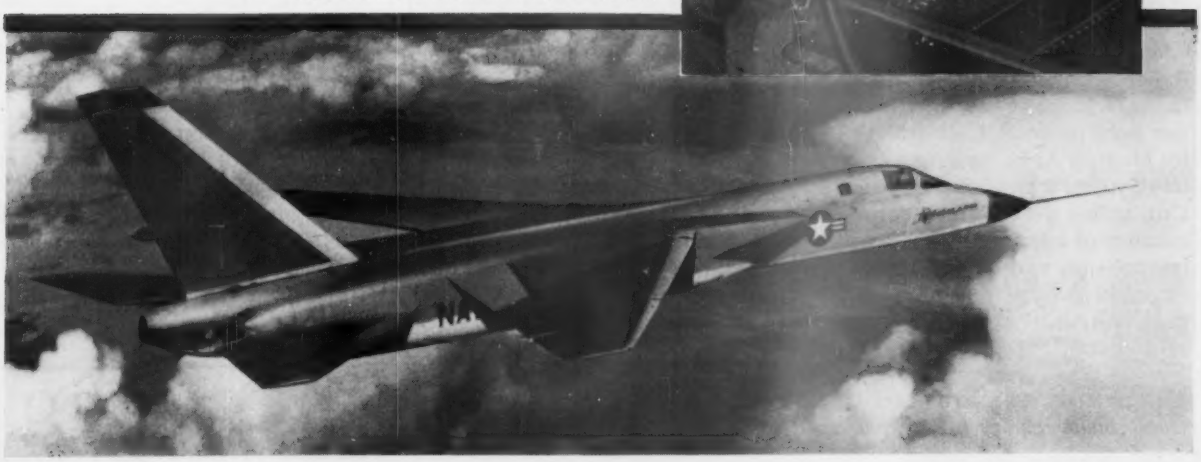

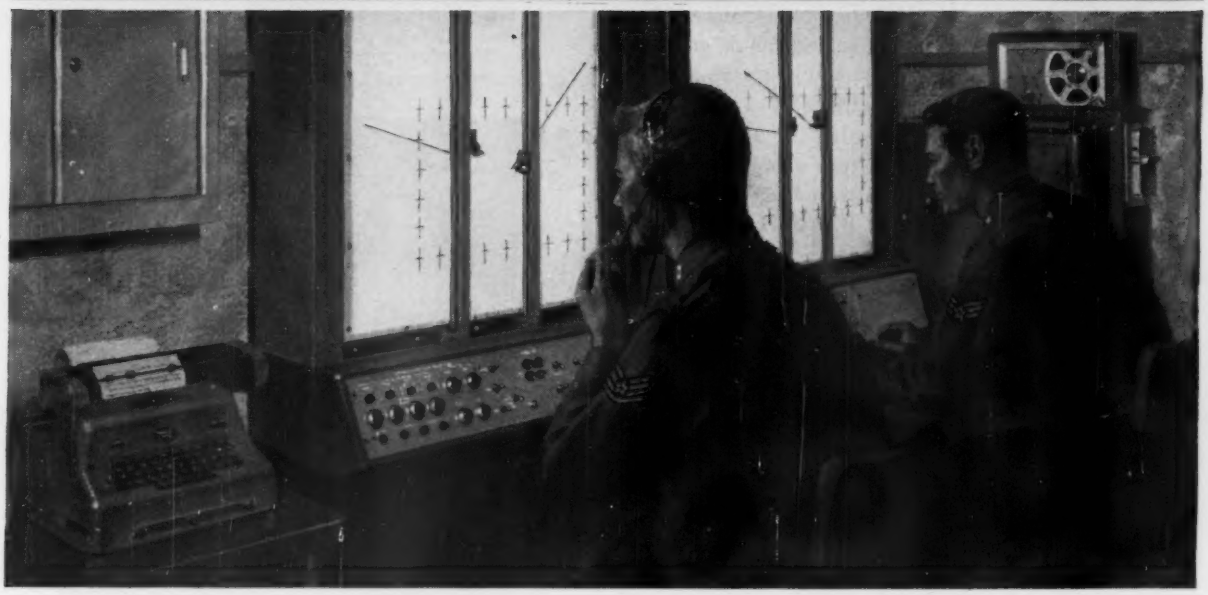

Cubic all-weather tracking system gives detailed analysis of ADC scoring missions

When a rocket or missile streaks from the armament bay of an interceptor over the Eglin Gulf Test Range and hurtles toward a target drone, a unique Cubic tracking system goes to work. Called MATTS for Multiple Airborne Target Trajectory System, it gives the Air Defense Command a complete running account of every phase of a scoring mission and prints out a full record of the intercept problem for later analysis.

MATTS has already demonstrated an unusually high level of reliability in continuous ADC operation. It has been scheduled as primary scoring instrumentation for ADC's next biennial weapons meet (Operation William Tell '61) to be held on the Eglin Range in October.

MATTS operates day or night, in any kind of weather, continuously measuring and plotting the trajectories of the interceptor, the missile and the target drone. The system tells everything about the mission, including the distance and direction of the missile from the target, and from the interceptor, at the time of simulated burst.

Cubic precision electronic tracking systems, of which MATTS is just one example, are in world-wide use for scoring, range safety, air traffic control, satellite geodesy and radar/telemetry acquisition. For information, write Dept. AW-106, Cubic Corporation, San Diego 11, Calif.

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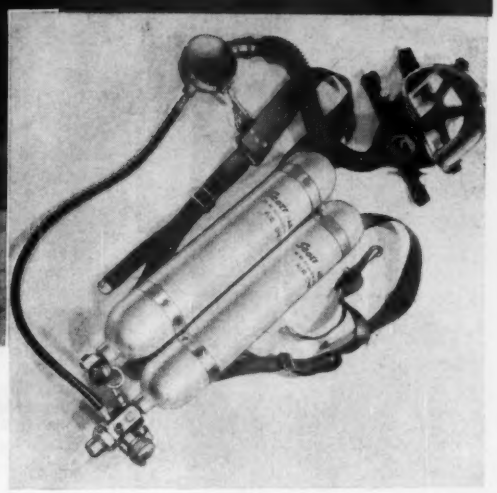

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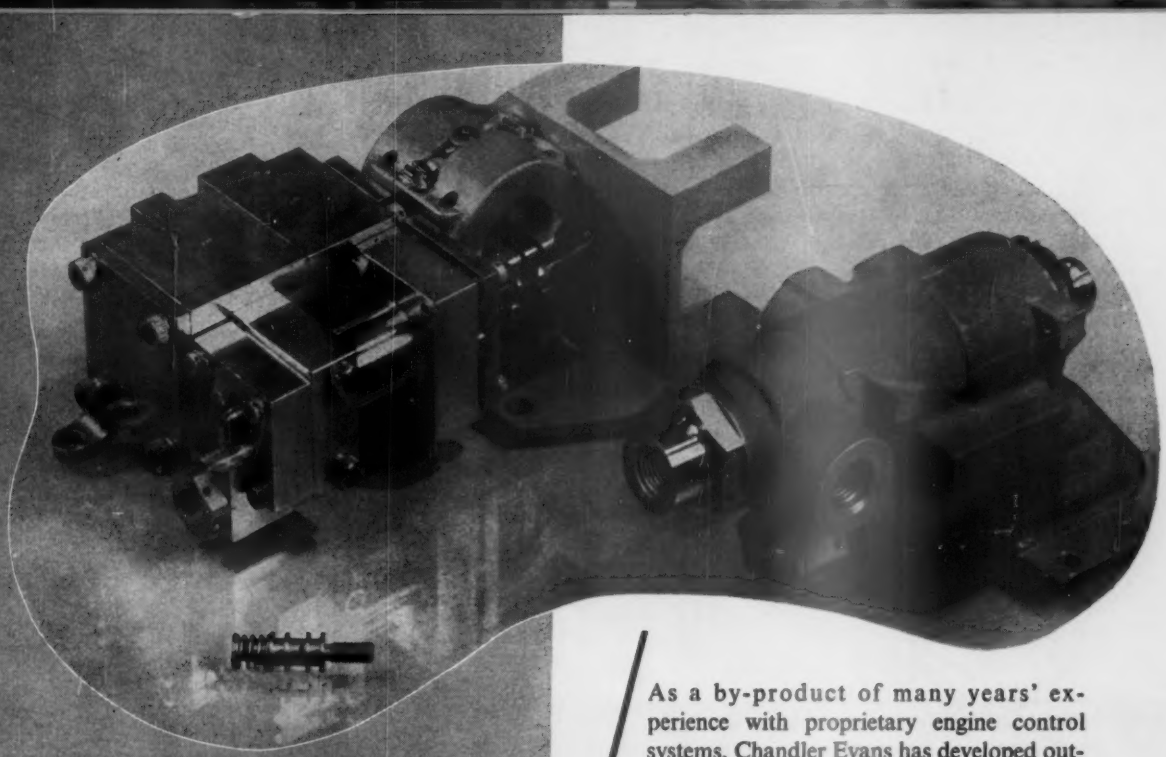

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Who saw the Crab Nebula first?

The year was 1054 and Chinese and Japanese astronomers dutifully recorded a heavenly explosion that occurred some 4,000 years before they saw it. This nova, then bright as Jupiter, faded from sight until the 18th century, when telescope-equipped observers rediscovered the nova remains, later named the Crab Nebula.

Today, such a stellar explosion would bring a world-wide family of J. W. Fecker telescopes into operation. In fact, almost *any* celestial novelty, supernova or artificial satellite, is observed through Fecker telescopes or tracking equipment. Often these observations are made continents apart and are timed within 700 seconds of each other . . . not 700 years.

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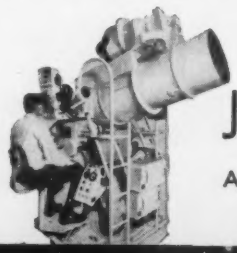

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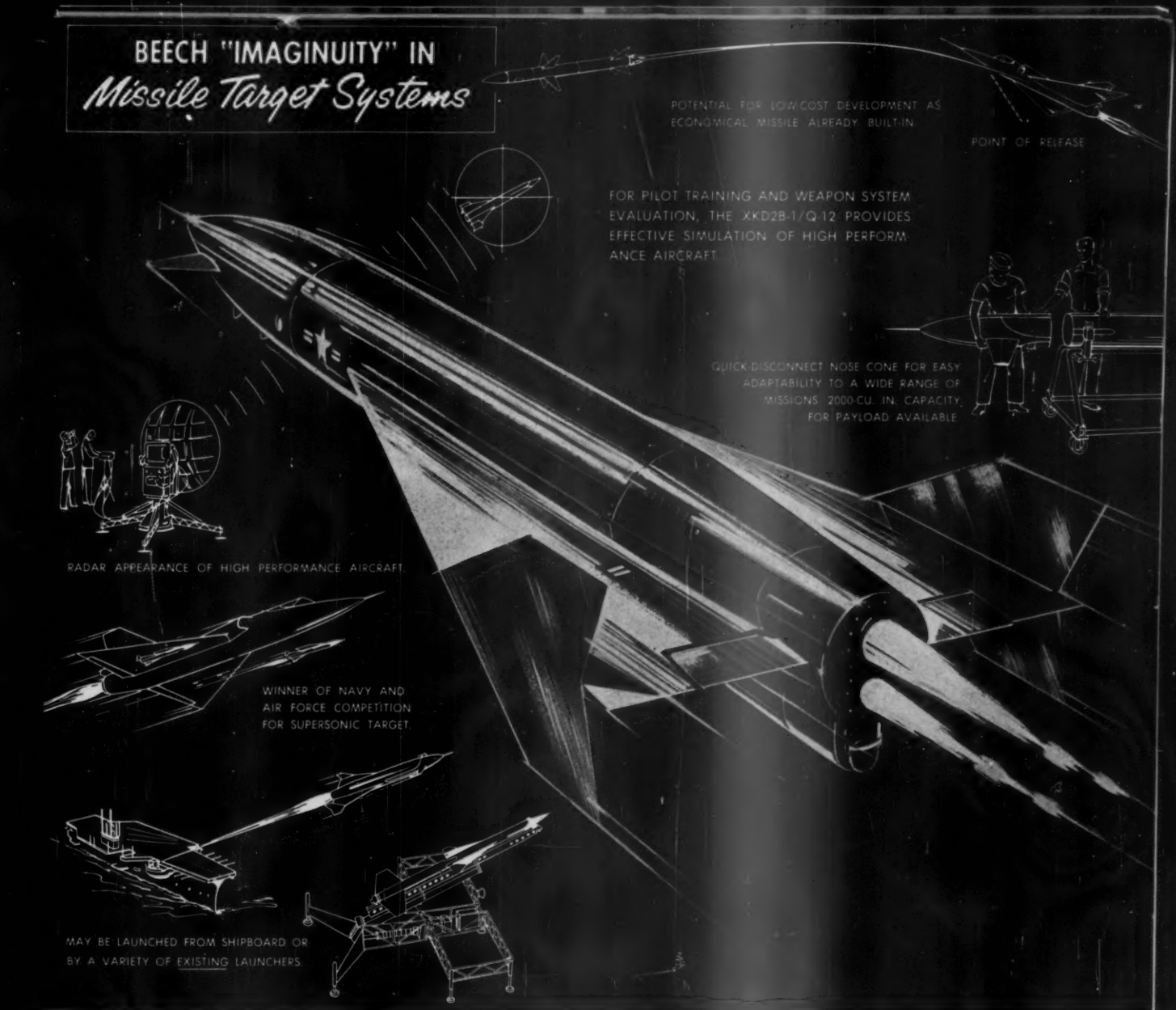
BEECH "IMAGINUITY" IN
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Navy XKD2B-1 and Air Force Q-12 . . . . .

Mach 2 target system developed by Beech also has promising potential as economical missile system

Born of Beech experience in many fields of modern weapon development, the Navy XKD2B-1 and Air Force Q-12 meets the need for a target system capable of simulating the speed, altitude and target characteristics of high performance aircraft. It makes possible, at low cost, realistic pilot training and effective evaluation of advanced weapons systems. Designed to score hits or misses. It has a pre-programmed guidance system, and can operate at altitudes from 1,000 to 70,000 feet.

In addition to its target capabilities, XKD2B-1 or Q-12 has great potential for further development as an economical missile system. It can carry a substantial payload to fulfill a wide range of future missions.

Beech *Aerospace Division*

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Beech Aerospace Division projects include R&D on manned aircraft; missile target and reconnaissance systems; complete missile systems; electronic guidance systems; programs pertaining to liquid hydrogen propellants and cryogenic tankage systems; environmental testing of missile systems and components; and GSE.

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MID-CONTINENT INTERNATIONAL AIRPORT,
KANSAS CITY 8, MISSOURI, U. S. A.

March 31, 1961

Mr. R. W. Whitesell
Director of Marketing
The Bendix Corporation
Bendix Products Division
South Bend 20, Indiana

Subject: Bendix Wheel and Brake Equipment

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Very truly yours,

S. L. Higginbottom
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Mr. Higginbottom's comments coincide with those of most commercial, military, and business aircraft people.

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Missiles Dominate Research Budget Plan..... 26
►$2.5 billion apportioned from $5.9-billion total; space allotted $703 million, aircraft $732 million.

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►14 carriers chosen for domestic, overseas airlift; CAB approval required but appears far from certain.

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►NASA's spacecraft, to be launched by Atlas-Centaur next year, will collect data as it passes within 16,700 mi. of Venus.

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COVER: Marine Corps Sikorsky HR2S helicopter maneuvers toward Aerobee rocket nose cone package's flotation gear so Marine suspended from cable can attach grappling hook and recover motion picture camera which photographed behavior of liquid hydrogen under zero-gravity conditions (AW Apr. 17, p. 61). Rocket was fired from NASA's Wallops Station, Va., as part of Lewis Research Center study related to Centaur and Saturn upper stage development. Aerobee attained 96.5-mi. apogee; recovery package landed 42 mi. offshore.

PICTURE CREDITS

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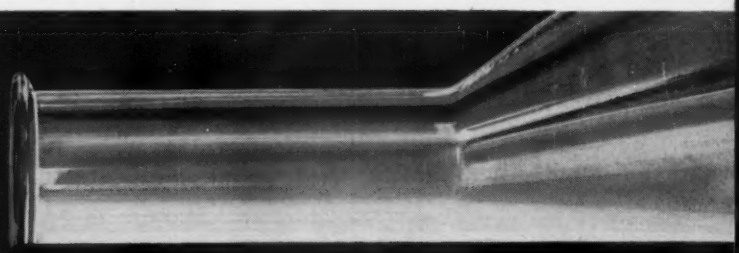

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EDITORIAL

New Image at Paris

Any American who has traveled extensively in Europe during the past few years has needed no Gallup poll or U.S. Information Agency survey to tell him that U.S. prestige generally, and particularly in technical areas, has deteriorated badly in the face of Soviet space achievements contrasted with apparent U.S. reluctance to extend its traditional pioneering spirit into space. Thus, it was indeed heartening to every American at the Paris Air Show to see the United States at long last put its very best foot forward by displaying its technical capacity from lightplanes to outer space, along with appropriate technical and operational personnel that reflected a genuine image to Europeans of what our country is really like.

U.S. participation in the Paris Air Show was expensive in money, material and lives, yet only Commander Shepard's Mercury space shot has done more in recent years to restore the picture of the real America that Europeans hope fervently still prevails. It is understandably difficult for anybody sitting behind a desk in Washington to feel the tremendous impact of U.S. participation in this show on more than half a million Europeans ranging from French school children to technicians from 24 nations. He could not see the tremendous flow of people surging through the U.S. space exhibit that impressed both the school children and the technicians.

Crowds around Commander Shepard's heat-scorched Mercury capsule were so thick it was necessary to move outside the space exhibit tent and organize the mass flow of people past it. Accompanied by French-speaking Clotaire Wood, advanced research program coordinator for National Aeronautics and Space Administration, the Mercury capsule appeared on every European television network and radio hookup possible during its 10-day exhibition.

Desk-bound Pentagonians could not imagine the impact of Maj. William Payne greasing a B-58 onto Le Bourget's wavy runway with hardly a puff of rubber smoke after a 6 hr. 15 min. nonstop flight, including an incredible 3 hr. 19 min. leg from New York to Paris, then taxiing up to the plaque on the airport tarmac where Lindbergh cut the engine of the Spirit of St. Louis just 34 years earlier.

The French understood and felt deeply this "Lafayette, we are here" gesture as Major Payne emerged from the cockpit looking lean, tanned and competent and managed a big grin and wave at the cheering crowd. A French policeman turned to American reporters and said "that is how we like to think Americans still are." The French tried hard to win the Bleriot Cup, which has been standing as an exclusive challenge to designers and pilots for 30 years. They came close with the Mirage IV in a 21-min. run at 2,000 kilometers per hour before blistering heat cut the run short nine minutes from Bleriot requirements. They appreciated the skilled performance required by the B-58 and its pilot, Maj. Elmer (Gene) Murphy, to win this coveted trophy.

In their all-too-brief days in Paris, Major Murphy and his crew made a tremendous impression on the technicians and military airmen of many nations they met, and all of them shared with us the tragedy of the fatal flight. Americans at the Paris show will never forget the sight of French villagers near the crater dug by the B-58 lining its blackened rim early Sunday morning with flowers, or the lines of French school children bringing flowers to Le Bourget Sunday and laying them on the Mercury capsule because it was the most tangible thing American accessible to them at the show, or the silent handshakes from French airmen and technicians conveying feelings too deep to be spoken. They understood far better than many desk-bound Americans that tragedy is an inexorable part of the price of progress, and they respect us as a breed that does not shrink from this prospect.

Another outstanding aspect of American participation in the Paris Air Show was the static and flying exhibition by the very latest USAF, Navy and Army planes, including four aircraft and two helicopters holding world records.

In contrast, the Soviets exhibited only the old familiar Tupolev 114, which has now pretty well established itself as an exhibition piece rather than a useful airline transport. This contrast between U.S. willingness to show its record-holding planes and Soviet reluctance to even display photos of its record-claiming planes was not lost on the European audience.

The Soviets' inability or unwillingness to display the promised new Tupolev 124 and Antonov 24 transports also raised European eyebrows.

U.S. exhibition of record-holding aircraft and flying display of the latest Mach 2-plus aircraft, such as the Republic F-105, Lockheed F-104, North American A3J, McDonnell F4H and Chance Vought F8U, coming on the heels of the open Mercury shot at Cape Canaveral, gave Europeans the impression of a strong, competent nation again flexing its technical muscles, dedicated to achieving the required superiority regardless of tardy starts in some fields, determined to reach its goals despite temporary setbacks and with the stamina to run the full course required.

This growing contrast of U.S. frankness in displaying its strength and discussing its problems with Soviet furtive secrecy regarding backup proof of its technical claims is making a tremendous impression on Europeans, and this pressure on the Soviets should be maintained at every opportunity to emphasize better than any words or propaganda broadcasts the essential difference between freedom and state slavery.

There may be some timid souls in Washington who might want to seize on the B-58 accident as an excuse for abandoning U.S. participation in international air shows. This same group fought desperately but unsuccessfully to ring down Iron Curtain secrecy on the Mercury shots, apparently under the same philosophy the Soviets show in announcing only successes. If this view prevails, the U.S. will suffer irreparable damage.

The significant point of both the open Mercury shot and the B-58 performances in Paris was the image they present to the world of a vital young nation still challenging the unknown and determined to master and harness new frontier science technology with the same vigor with which we expanded across the Alleghenies, the Rockies and the Pacific—willing to risk the chance of occasional failure, but determined to press on undaunted toward ultimate success. If we ever lose that feeling as a nation or fail to convey this to people everywhere, we can begin to carve our own epitaph on our tombstone as a nation.

—Robert Hotz

1-6 Commutator assembly—analog input
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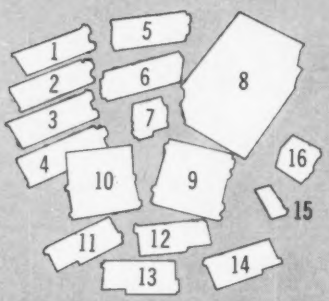

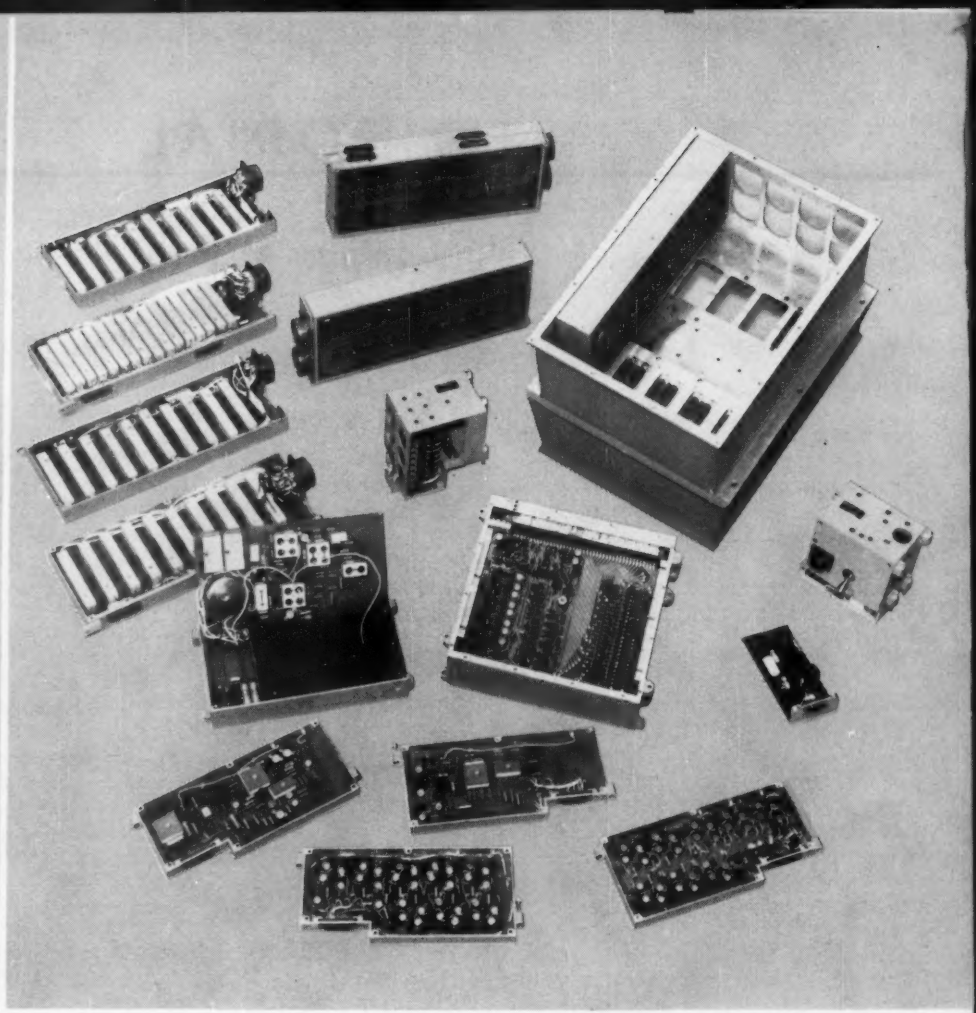

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WHO'S WHERE

In the Front Office

Lt. Gen. William H. Tunner (USAF, ret.), a director of Pioneer Aerodynamic Systems, Inc., Manchester, Conn. Gen. Tunner, former head of the Military Air Transport Service, will also serve the company as a consultant.

Col. Samuel W. Bishop (USAF ret.), president of Electronic Communications, Inc., St. Petersburg, Fla., succeeding **Frank W. Godsey, Jr.**, now vice chairman of the board.

Joseph A. Waldschmitt, president and chief executive officer of Page Communications Engineers, Inc., Washington, D. C., subsidiary of Northrop Corp., succeeding **Esterly C. Page,** now board chairman. Elected vice presidents of Page: **Glenn G. Peebles,** director of construction and installation; **Charles L. Ill,** director of administration. Also: **Richard E. Horner,** Northrop senior vice president, elected to the Page board, succeeding **Thomas V. Jones,** Northrop president, who has resigned from the Page board after a two-year term as chairman.

W. F. Wells, senior vice president and general manager, Midwestern Instruments, Inc., Tulsa, Okla.

John R. Harkness, vice president-marketing, Librascope Division of General Precision, Inc., Glendale, Calif.

Flight Research, Inc., Richmond, Va., has announced the following appointments: **John C. Pennock,** a vice president, as manager of the company's recently formed Western Division (Costa Mesa, Calif.); **Donald Bass,** elected a vice president to replace Mr. Pennock as head of Applications Engineering.

Leonard B. Johnson, a vice president, Dunn Engineering Corp., Cambridge, Mass. Mr. Johnson continues as manager of technical operations.

Robert P. Hubley, vice president-sales Los Angeles Airways, Inc.

Arthur S. Cosler, Jr., vice president-research and development, Geonautics, Inc., Washington, D. C.

Edward J. Tucker, corporate controller, American Airlines, Inc., and **William J. Corbett,** treasurer. Also: **Paul G. Larie,** a vice president; **Vincent J. Long,** assistant corporate controller; **Daniel L. Grimes,** general auditor.

Maj. Gen. Robert H. Warren, commander, Air Force Flight Test Center, Edwards AFB, Calif., replacing **Maj. Gen. John W. Carpenter, III,** who has been transferred to the Pentagon as Air Force deputy director of plans.

Honors and Elections

Dr. William Ker Wilson, chief research engineer of the de Havilland Engine Co., has been awarded the James Clayton Prize for 1960 by the Council of the Institution of Mechanical Engineers for his "contributions to mechanical engineering science, in particular for his theoretical and practical work on vibration, engine balance, gyroscopic loading and many associated problems. . . ."

(Continued on page 127)

INDUSTRY OBSERVER

► Industry proposals are scheduled to be submitted June 19 to NASA's Marshall Space Flight Center in the competition for a 15,000 man-hour study of a Nova launch vehicle offshore launch site to accommodate 12-million lb. thrust. Planned Saturn offshore site (AW May 8, p. 58) apparently has been dropped, since the Nova site could also handle Saturn.

► **Effectiveness of the Convair Redeye battlefield anti-aircraft missile is expected to be tested against helicopters next fall at Naval Ordnance Test Station, China Lake, Calif. Two Bell H-13E helicopters, fitted with remote control equipment, will be used as drone targets for Redeye. Bell Helicopter Co. will modify the H-13Es under a $208,000 Navy contract.**

► Fifteen air-to-surface Bullpup firings are planned in the shakedown program Navy is conducting at Pt. Mugu with the Martin missile powered by a Thiokol Reaction Motors Division liquid propellant engine. Subsequent tests may include Bullpup firings with a Rocketdyne solid fuel engine. Outcome of these trials, which Air Force is watching closely, may determine the emphasis Navy will put on the larger, higher performance Bullpup B, which may have a range of about 50 mi.

► **Raytheon and General Electric's Tempo are conducting Air Force-supported studies of advanced earth-satellite weapon systems. Boeing has a similar study contract under its Boss/Wedge program (AW Apr. 16, p. 26). Each of the three study contracts is for $200,000.**

► Effects of solid fuel rocket exhaust on characteristics of microwave transmission are being studied by the University of Utah under Air Force contract.

► **Rome Air Development Center is expected to turn over its experimental BMEWS radar at Trinidad to Atlantic Missile Range. RADC would retain a small part of the system for testing new equipment. AMR would use the radar for very precise tracking of missile flights.**

► Grand Central Rocket Co. is conducting a research program for the Air Force to determine feasibility of developing a solid propellant rocket engine with a mass fraction as high as 0.95. Laboratory tests with slurry-mixed nitroplastasol have indicated feasibility of proceeding with a test version of about 1,000-lb. thrust.

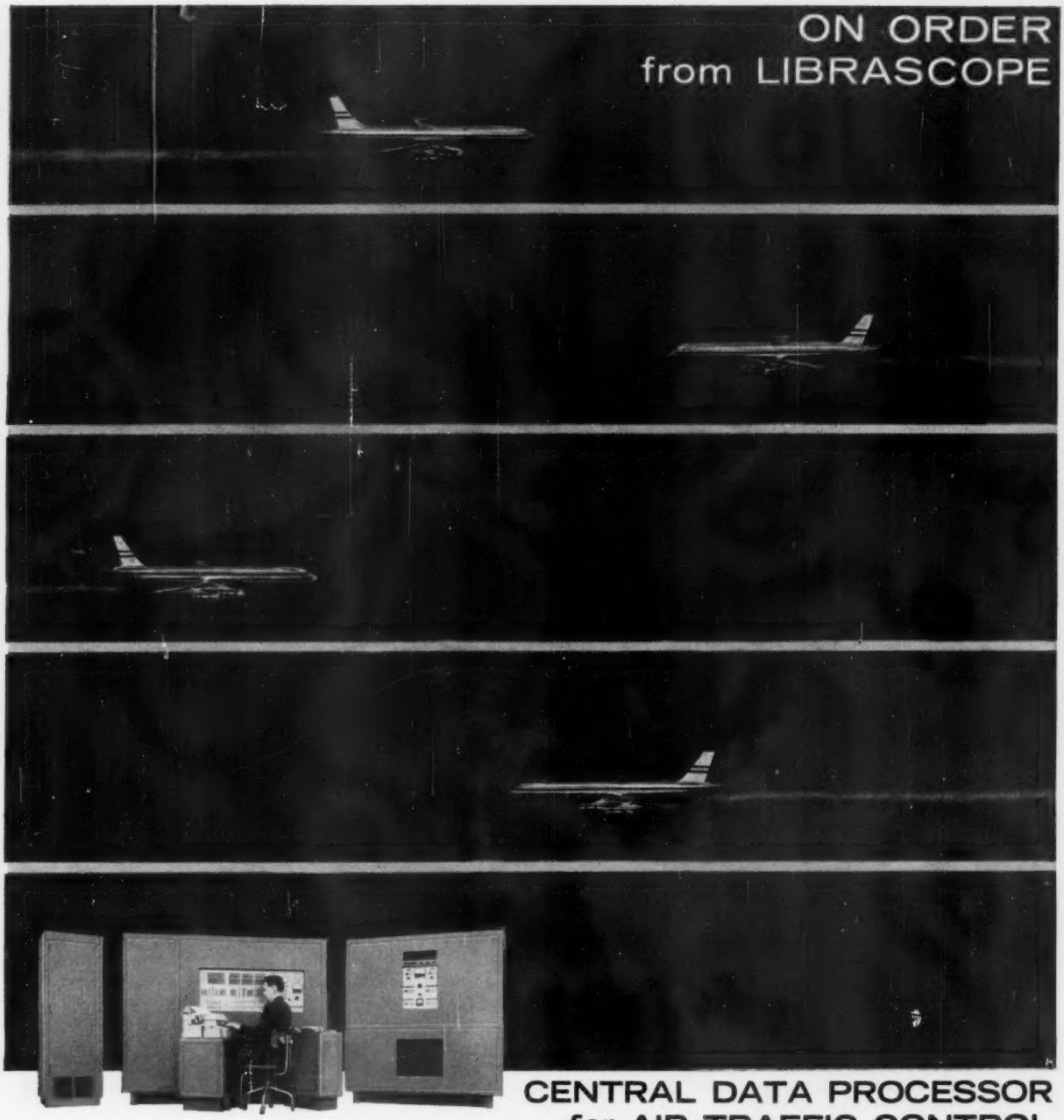
► **Chance Vought F8U-2NE is a new version of the limited all-weather fighter equipped with larger radar, which will provide improved tracking and target acquisition data for the interceptor's Sidewinder missiles. First F8U-2NE is nearing completion.**

► Method of handling high performance solid propellants by encapsulating spheres of the most sensitive ingredients within covers of the most inert ingredient is being developed by United Technology Corp. to prevent premature reaction during mixing. This method also produces a denser grain and requires new mixing equipment and techniques.

► **Aero Commander is preparing a proposal showing military high-speed transport and training capabilities of its new twin-turbojet Model 1121 Jet Commander design (AW May 8, p. 92).**

► McClellan AFB officials are proposing the California base to USAF as a reconditioning center for recoverable space boosters. They have asked the city of Sacramento to increase the height of a bridge over the Sacramento River so recovered boosters could be towed to the base. McClellan currently is a reconditioning center for USAF fighters and bombers.

► **Soviet scientists list among the new sciences resulting from space exploration, electrodynamics, which covers electromagnetic fields in the universe; nuclear astrophysics; space psychology, or the science of the consciousness and behavior of astronauts; and space ecology, or man's relation to the space environment and to his life on other planets.**



CENTRAL DATA PROCESSOR for AIR TRAFFIC CONTROL

Today, at a peak traffic hour, approximately 200 aircraft flew over the New York area. Each year this number will increase. Yet, the Federal Aviation Agency will continue to assure safe and efficient control of air traffic. One reason . . . a data processor developed for the FAA by Librascope to quickly and accurately handle the routine clerical tasks now occupying most of the controller's time. The first 18-unit data processor will be installed at Boston in 1962. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturer of computer control systems.

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Washington Roundup

Disarmament Plans

Apparent deadlock between the U.S. and the USSR on nuclear test ban agreements has not delayed the Kennedy Administration's program for expanded efforts in the disarmament field. The President's position is that the subject will recur periodically and the U.S. must develop a well thought out program on which to base any negotiations.

McGeorge Bundy, who is special assistant to the President for national security and White House liaison with the National Security Council, is now working over the fine points of a legislative proposal to establish a semi-autonomous disarmament organization. It probably will be headed by an under-secretary of state, who also would be a special assistant to the President.

Meanwhile, John J. McCloy, the President's disarmament adviser, has a small personal staff of four and is working through the State Department's Disarmament Administration, established last summer by former President Eisenhower. It is organized into four branches—administrative, political, policy planning and studies—and has expanded its staff to approximately 100. One contract has been let for outside support —to the Institute for Defense Analyses, for a study on stabilized disarmament.

Peace Research Institute, incorporated here recently, will seek to serve as a nonprofit coordinating center for contract studies and research if the proposed disarmament agency is created. It is headed by James J. Wadsworth, former deputy U.S. representative to the United Nations and chief U.S. negotiator on disarmament in the Eisenhower Administration. He is a brother-in-law of Sen. Stuart Symington, former USAF secretary. One of the incorporators is Arthur Larson, former head of the U.S. Information Agency and special consultant to former President Eisenhower.

American Telephone & Telegraph Co. is considering using circling aircraft as emergency microwave-telephone links in case of war or other catastrophe. AT&T President Frederick R. Kappel also said last week that a new hardened cross-country cable system will have all its repeater and switching stations installed in heavily reinforced concrete underground vaults, and that certain key stations will be manned around the clock. Tests indicate the new cable will withstand bomb blast overpressures greater than 200 psi.

Information Blackout

Crackdown on defense information has been extended by the Pentagon to defense contractors, affecting both their public relations and advertising policies. Despite these new limitations, some members of Congress would like to take action of their own.

House defense appropriations subcommittee members have shown concern over the amount of information disclosed through company press releases and ads and the fact that some of the cost for these is charged against the government. Several suggested it is now time to write limitations into the defense money bill.

Air Force Under-Secretary Joseph Charyk told the subcommittee he agrees completely that "there has been far too much publicity in regard to our whole space program together with a tremendous amount of discussion about things that we are going to do." He said this is "basically unhealthy," and that a better public relations policy, aimed at releasing much less information, is getting considerable thought.

Certain steps already have been taken to ensure that contractors' public relations actions are in consonance with those of the Air Force and Defense Department, Charyk said. Defense Secretary Robert McNamara said late last month that he intends to investigate, when he has time, whether "the rather substantial amounts that may be spent . . . for advertising items that are procured only by the Defense Department are warranted." Earlier, he said he intends to "re-educate" contractors, defense employes and the press in an attempt to reduce the amount of military information that is disclosed.

Navy Chief Race

Adm. James S. Russell now leads the speculation on who will be the next chief of naval operations on the theory that the Kennedy Administration will use the "feeding up" technique—promoting a man who already has experience at the Joint Chiefs of Staff level. Russell, as vice chief, has served as acting chief in the absence of Adm. Arleigh Burke. Burke was selected as chief by former President Eisenhower from far down the promotion list, but that is the exception rather than the rule.

Subscribers to the "feeding up" theory point to Air Force Gen. Curtis LeMay's promotion from vice chief to chief. But Vice Adm. John T. Hayward, deputy chief of naval operations for development, still may be in the running for the top Navy job. He is said to have the support of a number of Democratic national committeemen.

Navy, aware of the public relations problems Air Force created by naming a military satellite project "Saint," decided to call its anti-satellite rocket project "Early Spring" on the theory that no one is against motherhood or an early spring.

—Washington Staff

Missiles Dominate Research Budget Plan

$2.5 billion apportioned from $5.9-billion total; space allotted $703 million, aircraft $732 million.

By Katherine Johnsen

Washington—Defense Department is programing approximately $2.5 billion for Fiscal 1962 research, development, test and evaluation of missiles—by a wide margin the major area of emphasis.

Two other major fields of effort were disclosed in hearings on the Fiscal 1962 Defense budget for research and development released last week by House Appropriations Committee.

They will be:

- **Aircraft,** $732 million.
- **Military astronautics,** $703 million. This has increased steadily from $421 million in Fiscal 1960 and $502 million in Fiscal 1961.

The department's planned total research and development effort for the coming year of $5.9 billion in direct obligations is $500 million below the Fiscal 1961 level. Expenditures are expected to continue to rise to $6.2 billion in Fiscal 1962—from $5.8 billion in Fiscal 1961 and $5.3 billion in Fiscal 1960.

By service, programed obligations are:

- **Air Force:** missiles, $1.33 billion; aircraft, $598 million; space, $608 million.
- **Navy:** missiles, $683 million; aircraft, $87.9 million; space, $23 million.
- **Army:** missiles, $464 million; aircraft, $45.9 million, space, $72 million.

Highlights of trends in research and development discussed by Defense witnesses before the appropriations subcommittee on the armed services were:

- **Strategic bomber.** Dromedary concept—referred to as "a Polaris of the air" concept—is under "serious" consideration as a possible successor to the B-52 and alternative to the B-70, according to Dr. Herbert York, former director of defense research and engineering, who headed Defense presentation. Dromedary would be a subsonic missile launcher aircraft with high payload and high endurance capabilities—characteristics which Defense Secretary Robert S. McNamara outlined as desirable in a B-52 successor during previous congressional testimony (AW May 15, p. 28). Dr. York estimated it would be able to stay in the air two or more days without refueling. Joseph V. Charyk, USAF under-secretary, told the subcommittee that it would be "relatively invulnerable" and would "probably be a turboprop aircraft." He noted that it could fill a limited war role in controlling airspace—as well as delivering strategic weapons—since it could carry a powerful radar system and air-to-air missiles. Charyk reported that studies of the concept are directed at both technical and cost effectiveness aspects. One study of the concept has been assigned to the Rand Corp.
- **Soviet hypersonic glider.** Dr. York anticipated that the Soviet Union is moving in the direction of Dyna-Soar and developing an aerodynamically controllable re-entry vehicle because "it is easy for them to do at the present time because they have twice the payload capability. Dyna-Soar is something which we can just barely do with our present rockets. It is something that could be quite easily done with a rocket of their size." Charyk pointed out that USAF is confronted with "a major task" in the design of a Dyna-Soar vehicle maneuverable at hypersonic speeds.

Dr. York said Defense considers Dyna-Soar a "serious program"—but "not a high priority program." Lt. Gen. Roscoe G. Wilson, USAF deputy chief of staff, development, called it "the most important program we have in the Air Force because we will never be able to talk about space flight until we are able to take off at the pilot's option, control the vehicle and return it at the pilot's option." USAF's Fiscal 1962 request of $120 million was reduced $20 million by DOD.

- **Space threat.** Dr. York estimated that within "five, or perhaps even less" years space systems could become a direct military threat, but he resisted suggestions by congressmen that the U.S. should develop space missile launchers.

Charyk observed that any international ban of military satellites will be "near impossible" to police.

- **ICBM reliability.** Charyk expressed concern that the nuclear test moratorium will preclude reliable warheads on future missiles. Even though ICBMs with nuclear warheads have never been actually fired, Charyk was confident of their effectiveness because all of the elements, including the final signal to detonate, have been checked. "In the present missiles, we have actually tested the warhead design. . . . But if we extend our extrapolations much beyond the present extrapolation, a high factor of uncertainty enters as to the effectiveness of the warhead."
- **Minuteman.** Dr. York's testimony added to the appropriations subcommittee's skepticism that mobile Minuteman will ever become an operational reality. After pointing out that fixed Minuteman on hardened sites is cheaper and a superior bombardment weapon, Dr. York questioned whether mobile Minuteman should be credited with greater invulnerability.

"They are not as invulnerable as one might suppose," he said.

"Furthermore, we believe that the fixed Minuteman in large numbers will survive simply because of the trade-off, the number that he [the enemy] has to have in order to destroy them is so very much larger than the number we would have."

- **Anti-submarine warfare.** Dr. York viewed Navy's problem of policing the seas and meeting the submarine threat as a long way from solution. Despite many years of research and development, he said, "there remain a number of tough, unyielding problem areas." Present programs will help, he said, "but development of novel and extremely large, high-powered sonars will be needed." Areas "which hopefully might lead to major advances," he said, are: "infrared detection of submarine wakes, improved magnetic airborne detectors, noise reduction, sonar target classification."
- **Nike Zeus.** Dr. York presented the most adverse congressional testimony to date on the prospects for Nike Zeus. "It is generally agreed that Nike Zeus in its present design would be relatively ineffective against a determined high-level enemy attack," he said. Because of its small radius, he estimated cost of adequate deployment at $15 billion.
- **Chemical, biological,** radiological warfare. With support from Defense Department, Army is moving forward with an expanded research program in this type of warfare—directed primarily at defensive and offensive operations on the battlefield. Army testimony empha-

Bomber Funds

Washington—House and Senate conferees last week agreed on a $12.5-billion defense procurement authorization bill, adopting the $525 million added by the Senate for Boeing B-52 bombers rather than the $337 million which the House wanted for B-52s and for Convair B-58s. They also accepted the $21.2 million added by the House for turbofan engines for 15 Boeing C-135 cargo transports and $8 million for an executive jet aircraft. House had voted $25 million for three executive airplanes, the Senate nothing. Both houses are expected to approve the bill without change.

Air Force Research, Development, Test and Evaluation Program

This is the detailed breakdown of USAF's proposed $1.93-billion Fiscal 1962 research, development, test and evaluation program — compared with the Fiscal 1961 program—as presented to the House Appropriations Committee.

In addition, USAF plans to use $1.12 billion of its Fiscal 1962 procurement funds to finance research, development, test and evaluation on five projects: Atlas, $73.5 million; Titan, $356.4 million; Minuteman, $377 million; B-70, $218 million; and the C-141 turbofan cargo aircraft for Military Air Transport Service, $98 million.

	FY 61	FY 62
Strategic systems, total	$409.3	$406.5
Atlas	4.6	1.0
Titan	3.3	2.0
Minuteman	4.2	3.5
Samos	273.8	276.0
Skybolt	111.1	89.0
Penetration aids	12.3	35.0
Air defense systems, total	123.0	217.4
GAR-9 missile and ASG-18 fire control	15.0	16.4
Midas	107.4	201.0
Bomarc	.6	0
Tactical systems, total	4.7	4.2
Bullpup	4.7	4.2
Control and support systems, total	57.8	88.6
Air weapons control system	4.5	4.0
Continental aircraft control and warning	1.2	0
Norad combat operations center	1.0	2.5
Traffic control, navigation, landing system	1.4	1.0
Weather observation	3.9	2.8
Intelligence data handling	1.0	6.1
Materials handling	1.0	0
SAC control system	16.0	8.0
Electromagnetic intelligence system	6.4	14.8
Headquarters command and control system	1.0	.7
Nuclear detection	2.0	0
Communication system	14.1	12.7
Space detection and tracking system	3.3	30.0
VTOL transport	1.0	6.0
Operational support, total	32.8	39.1
Support equipment	2.2	3.1
Guidance and weapons	4.3	7.4
Electronics and communications	18.1	20.1
Reconnaissance and intelligence	5.3	5.3
Human factors	1.7	2.0
Targets and drones	1.2	1.2
Advanced development, total	386.0	406.7
Advanced systems, total	245.0	267.1
Discoverer	55.1	54.9
X-15	14.9	7.0
Blue Scout	5.6	15.0
Dyna-Soar	58.0	100.0
Aircraft nuclear propulsion	72.0	0
Studies	5.0	4.7
Tri-service fighter	24.6	55.0
Saint	6.1	26.0
Aerospace advanced propulsion	0	1.0
Ballistic missile defense-electronics	3.5	3.5
Hiller tilt-wing	.2	0
Test instrumentation, total	14.0	16.7
Subsystems and components, total	7.0	10.0
Pluto propulsion	7.0	7.0
Recoverable boosters	0	3.0
Development support, total	120.0	112.9
Rand Corp.	13.5	11.6
Analytic Services, Inc.	1.0	1.0
Lincoln Laboratory	14.6	15.3
Mitre Corp.	22.9	15.0
Space Technology Laboratories	41.6	34.8
Aerospace Corp.	26.4	35.2
Research program, total	285.4	319.4
Applied research, total	243.3	266.9
Nuclear weapon effects	.3	0
Nuclear applications	2.5	3.9
Support equipment technique	1.0	1.3
Decelerations	2.1	1.0
Materials	19.8	19.9
Navigation and guidance	20.8	22.4
Flight control	8.8	8.3
Weapon fire control	3.4	6.9
Vehicle defense	2.1	2.0
Comptroller technique	.8	.4
Advanced weapon	4.1	7.0
Mechanics of flight	10.9	17.7
Propulsion	44.7	51.2
Flight vehicle power	14.1	18.0
Surveillance technique	20.2	20.9
Communications	10.1	10.1
Electromagnetic warfare	15.3	13.6
Electronic technique	13.8	12.1
Reconnaissance	9.4	12.0
Electromagnetic vulnerability reduction	8.6	3.9
Intelligence technique	3.5	5.6
Electromagnetic wave technique	3.1	2.7
Aerospace environment	8.9	8.7
Life support	6.8	6.8
Aerospace medicine	1.8	1.8
Radiobiology	.1	.4
Human performance	2.2	2.9
System syntheses and analyses	4.1	5.4
Basic research, total	42.1	52.5
Propulsion	9.0	11.7
Materials	11.1	14.8
Electronics	7.5	9.7
Geophysics	3.8	5.0
Biosciences	2.8	3.1
Aeromechanics	7.9	8.2
Command operations, total	469.8	450.0
Civilian personnel	159.9	160.7
Contractor-operated installations	125.5	118.9
Supplies and equipment	69.5	78.6
Other	114.9	91.8
Grand Total	1,768.8	1,931.9

sized that progress in this field is still mainly at the laboratory level and that the magnitude of problems "just overwhelms us." Army has $61 million in Fiscal 1962 research funds earmarked for CBR warfare, and USAF has $900,000 earmarked for studies on dispersal vehicles.

Army's offensive incapacitating agent program is "still in research," Maj. Gen. Marshall Stubbs, Army's chief chemical officer, reported, and it is "investigating chemical and biological materials which would interfere with mental or physical processes but which permit no permanent injury or effect." Work is also under way on defoliating agents for use in forested warfare areas.

Polaris missile is allocated $443 million of the $1.3 billion in new funds requested by Navy. Other missile projects in Navy's Fiscal 1962 research and development program are: Typhon ship-launched surface-to-air missile for simultaneous firing at multiple targets; Sidewinder 1C (Sarah), radar guided version of Sidewinder, designed to help give the F8U-2 Crusader a limited all-weather capability; Subroc submarine launched nuclear warhead missile system; improvements in Sparrow III, Terrier, Talos; Bullpup; ARM lightweight air-to-surface missile; and preliminary studies of a ship-to-surface missile for amphibious landings.

Aircraft in the Navy program include: A2F low altitude attack aircraft scheduled for fleet introduction in 1963; A4D-5, with a 25% range increase over present A4Ds, also scheduled for introduction in 1963; F4H-1 Phantom all-weather interceptor; A3J-1 Vigilante, now under final weapon testing; start development of the Marine assault helicopter ASH; and complete development of the drone ASW helicopter DASH and early warning Hawkeye.

The main projects in Navy's astronautics program are $17 million for Transit navigation satellite and $4.2 million space telecommunications tests.

Approximately $600 million of Army's $1.2-billion Fiscal 1962 program is allocated to four projects: Nike Zeus, Advent global communications space program, Pershing solid-propellant missile, and Mauler anti-missile and anti-aircraft defense system. Nike Zeus, the largest of the four, is allocated $266 million.

CONVAIR B-58 supersonic bomber, which earlier had established a transatlantic speed record, makes its lone Paris Air Show pass over the Le Bourget runway seconds before the plane crashed, taking the lives of all three crew members.

Record-Setting B-58's Crash Mars Paris

By Cecil Brownlow

Paris—Flying display of aircraft from 14 nations that capped the successful 24th Paris International Air Show was marred on the first of two flying days by the loss of a Convair B-58 supersonic bomber and its three-man crew seconds after a low pass over Le Bourget Airport.

United States Air Force investigators from the Strategic Air Command's 16th Air Force based in Spain and the Seventh Air Division stationed in England were still sifting for clues late last week in the deep crater the B-58 dug into a field of oats six miles northeast of Le Bourget when it exploded on impact with the ground.

On-the-scene reverberations from the crash were doubly severe since the aircraft itself had earlier provided a highlight of the show by setting a new transatlantic speed record and the crew flying it at the time of the accident had received the Bleriot trophy here for establishing a new closed-course speed record (see pp. 108-109).

As a part of the static display on the days prior to the flight exhibition, the aircraft had vied for popularity with another U.S. exhibit—the National Aeronautics and Space Administration's "Freedom 7" Mercury capsule that carried Cdr. Alan B. Shepard, Jr., on his flight down the Atlantic Missile Range in early May (AW May 15, p. 31).

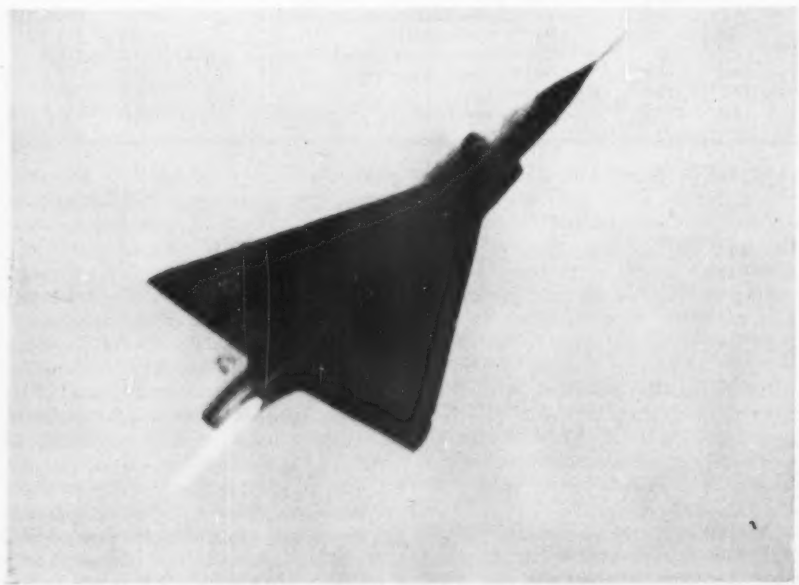
The B-58, piloted by Maj. Elmer E. Murphy, was one of six late-model U.S. aircraft in the air at the time for individual high-speed passes over the airport. The flight plan called for Maj. Murphy to make a low pass at a speed of approximately 550 kt., begin his climb to altitude with afterburner and execute a roll while still in view of the air show crowd.

Maj. Murphy made his pass, began his climb, turned on the afterburners, closed them again and was in the process of the roll when his aircraft disappeared into the low ceiling hanging over Le Bourget at an estimated altitude of approximately 4,000 ft.

That was the last seen of the aircraft by observers at the show or by Maj. Murphy's comrades in the air, although some on the ground and in the air witnessed a thin trail of white smoke rising from the ground northeast of Le Bourget seconds after the plane disappeared.

The smoke trail was formally reported to the Le Bourget tower for the first time by the pilot of the Lockheed F-104 in the flyby demonstration as he passed over the area.

Also in the aircraft at the time were Maj. Murphy's fellow recipients of the Bleriot trophy—Maj. Eugene F. Moses, navigator, and 1st Lt. David F. Dickerson, defensive systems operator. All three were attached to SAC's 43rd Bomb Wing, Carswell AFB, Tex.



EXPERIMENTAL Dassault Mirage III, equipped with a 3,310-lb.-thrust SEPR 844 rocket engine housed in the fuselage for added thrust, makes pass over Le Bourget.

DASSAULT MIRAGE IV, Mach 2 bomber scheduled to play a major role in France's emerging nuclear strike force, passes over Le Bourget in refueling position behind a Sud Vautour bomber modified to tanker configuration. Note Mirage's belly radome.

Show Flyby

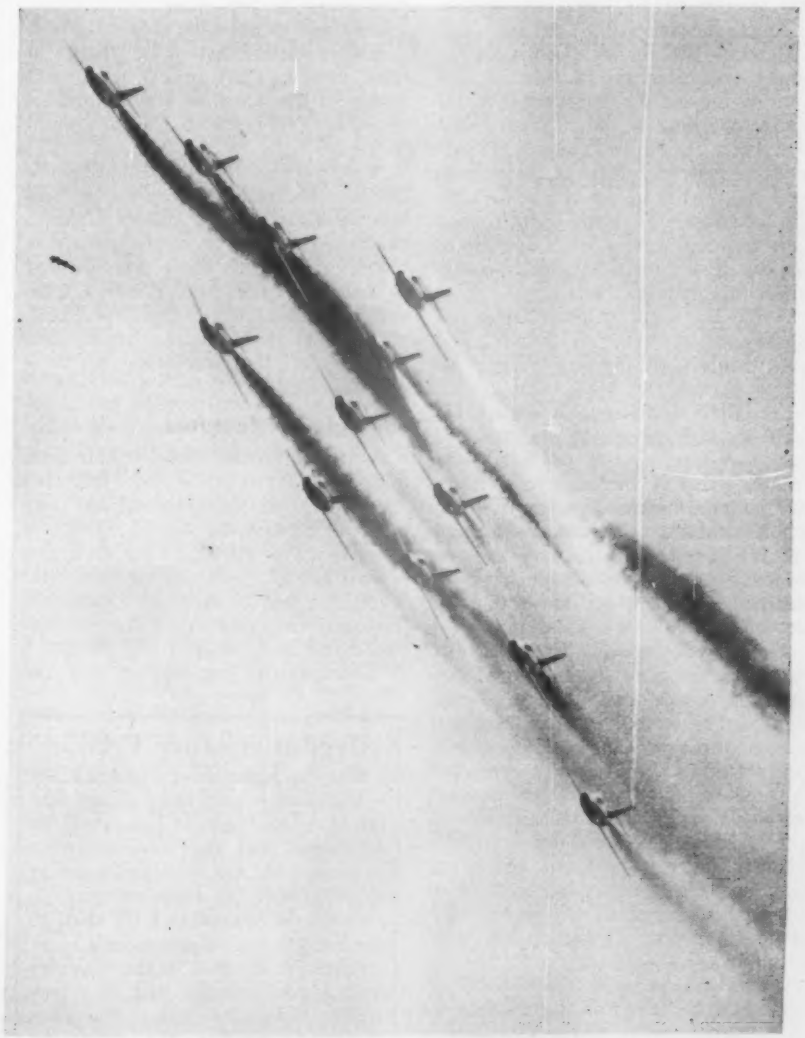
Award of the trophy at the air show stemmed from a May 10 flight by the Murphy crew in the U.S. in which the crew's B-58 flew a closed course of 669.438 mi. in 30 min. 43 sec. at an average speed of 1,302.07 mph. The flight was the first to meet the stipulations laid down in 1930 by pioneer French aviator Louis Bleriot for the permanent possession of the trophy which specified that an aircraft should fly a closed-circuit course at a minimum speed of 620 mph. for a period of at least 30 min.

On May 26, opening day of the air show, the B-58 then piloted by Maj. William Payne, also a member of the 43rd Bomb Wing, had gained a stroke for the U.S. in the international prestige race with its nonstop transatlantic flight that initially began at Carswell AFB. Total elapsed time between Carswell and Le Bourget including two in-flight refuelings was 6 hr. 15 min., of which 1 hr. 49 min. was flown at speeds of Mach 2.

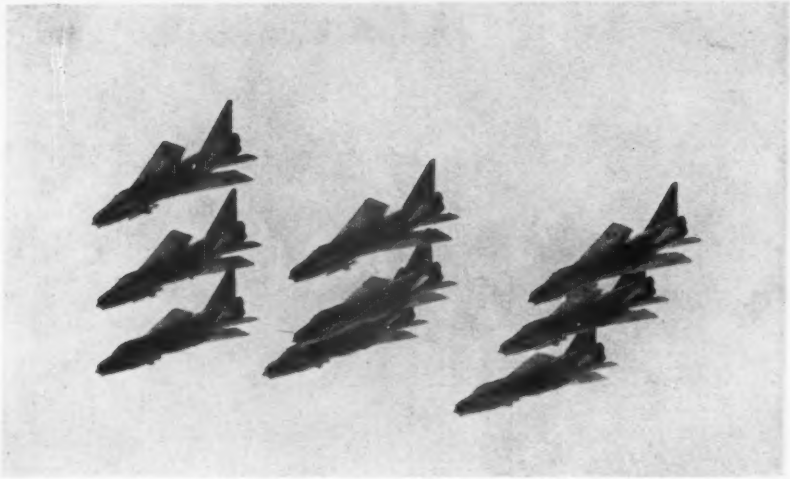
Flight leg between New York and Paris was 3 hr. 19 min.

Some top USAF officials and Convair personnel at the air show urged after the crash that a second B-58 be rushed from the U.S. to France so that it could fill the gap in the final day's flyby and dampen, if not completely offset, any adverse effects on French public opinion from the previous day's crash after the aircraft had made such a promising beginning in this area.

The proposal was vetoed in the Pentagon, but the U.S. pilots flying the F-104, the Republic F-105, Chance Vought F8U, North American A3J and McDonnell F4H showed the final day's



TWELVE Dassault Mystere IVAs of French air force's Patrouille de France acrobatic team trail red, white and blue smoke, tricolors of their nation, during a low-altitude pull-out at show. French team concluded its act with traditional bomb-burst finale.



NINE MACH 2 English Electric P.1 Lightning interceptors make a low-speed pass in the first public acrobatic demonstration of this British aircraft.

crowd of an estimated 200,000 that, despite the tragedy, they could push their aircraft to the limits allowed by air show officials.

Although the aircraft crashed almost immediately after its first flyby, it had been in the air for approximately 30 min. at the time of the accident. Maj. Gen. Perry B. Griffith, deputy USAF inspector general for safety, arrived on the scene on the following day to head the investigation team which was quartered temporarily at Le Bourget but has now moved its headquarters within metropolitan Paris.

While the U.S. made a large and effective effort with its aircraft and space exhibits, the Soviets officially let the show slide by with scant official notice after displaying an earlier enthusiasm and promising to have at least two new aircraft on hand, the Tupolev Tu-124 medium-range transport powered by two Soloviev turbofan engines and the Antonov An-24 cargo and troop transport powered by two Ivchenko turboprop engines. Also missing was the older four-turboprop Antonov An-10.

The only Soviet aircraft to reach the show was the giant Tu-114 turboprop transport which had been displayed here in 1959 and has been seen and inspected in a number of world capitals. During the show its doors remained closed to visitors, and it took no part in the flyby demonstrations.

The Union Syndicale des Industries Aeronautiques (U. S. I. A.), official air show sponsors, received no word as to why the later aircraft had been withdrawn or, in fact, that they had been withdrawn.

There was speculation that the Russians were miffed over the withdrawal of an invitation to Soviet Cosmonaut Maj. Yuri Gagarin to appear as a special guest at the show on May 31 and hold a joint press conference with Cdr. Shepard as well as the good reception the U. S. exhibits were receiving in the early days of the show before their aircraft had been scheduled to arrive.

Soviet technicians were here in force, however (AW June 5, p. 32) and on June 1 the mayor of Moscow and an entourage of 15 persons paid a visit to the show.

A spokesman for the Union Syndicale des Industries Aeronautiques said last week that, while disappointed in the Soviets' failure to display their new aircraft, this year's show was the first in which Russian and Western technicians mingled to any extent on "both commercial and political levels, and here we feel that something has been accomplished."

Lightplanes Featured

In the organized flying displays on the last two days of the show following eight days of static exhibits and sporadic demonstration flights, a total of 39 flybys were scheduled for each day, almost half of them coming from light aircraft, a market in which established European manufacturers are putting more and more interest and effort.

There was no participation this year, however, by a U. S. military acrobatic team, and the nine-plane formation of Mach 2 English Electric P.1s carrying Firestreak air-to-air missiles under each wing accounted for the newest addition, making a series of formation low passes, tight turns and other precision maneuvers over the airfield. On the first day, a single P.1 also executed a four-point roll during a low pass over the field. There had been no schedule for a repeat solo performance on the final day.

Making its first public appearance, the group was formed within Royal Air Force Squadron 74, the "Tiger Squadron," based at Coltishall, England, and is led by Squadron Leader John Howe. Speeds attained during the demonstrations at Le Bourget approached the sonic level at times.

Another scene stealer was the Czechoslovakian Zlin 326 two-place low-wing monoplane powered by a Walter Minor 160-hp. engine which demonstrated a high maneuverability capability as its able pilot paced it through a series of slow rolls, low passes and tight turns. Flying during the morning program, the Zlin pilot left the remaining lightplane demonstrators hard put to find anything to top his efforts.

Other flight demonstrations:

- **Nord Griffon** experimental aircraft with turbine-ramjet powerplant similar to types being studied for supersonic transports.
- **Dassault's** two-place delta-wing Mirage IV supersonic bomber scheduled to join France's nuclear strike force in 1963 made a series of passes over the field as opposed to the lone, high-speed run during the last show in 1959. In one pass, the Mirage IV, a large belly radome clearly visible in the forward fuselage section, came over at low speed in refueling position with a Sud Vautour bomber modified to tanker configuration.
- **Patrouille de France,** French air force acrobatic team, flying 12 Mystere IVAs in tight maneuvers and trailing red, white and blue smoke tricolors of their nation during formation rolls and the by-now traditional bomb-burst finale for such performances.
- **Flyby of 14 Dassault** Mirage IIIs, standard French air force interceptor, with missile stores in place.

As a near finale and reflecting the buoyant atmosphere in which this year's show has been conducted as a result of recent French technical and sales successes, 10 light Sud Alouette helicopters took to the air trailing lettered streamers spelling out their commercial achievements—almost 800 sales to date. As they did so, a heavy Sud Frelon 3200 prototype, forerunner of the 3210 which also seems destined for foreign sales, if on a moderate scale, sauntered proudly back and forth.

Reconnaissance F-105s

Paris—Six squadrons of Republic F-105 fighter-bombers now being phased into the U. S. Air Forces in Europe will be re-equipped with the bomb-bay reconnaissance pods now being developed by Republic under Air Force contract.

Under the concept, an F-105 could be converted to a reconnaissance role by installation of the pod in the bomb-bay unit, and be switched back to a pure strike vehicle within a short time when the mission requires. The aircraft also could serve a dual mission by carrying the weapon stores on wing pylons.

Mercury-Redstone Procedures Simplified

By Edward H. Kolcum

Washington—Procedures for the next manned Mercury ballistic mission will be modified to eliminate some of the 110 performance and monitoring tasks required of Astronaut Cdr. Alan B. Shepard during his flight May 5 in Mercury-Redstone 3.

Cdr. Shepard made 78 voice communications, monitored 27 major capsule functions and performed five attitude maneuvers during the 15 min. 22 sec. flight. The flight plan accounted for every second of the mission, according to Walter C. Williams, associate director of the National Aeronautics and Space Administration's Space Task Group, who said the plan for MR-4 will require only pilot functions necessary for a successful mission, thus providing more time for observation.

This change was reported last week at a conference on the medical results of the MR-3 flight held under the joint sponsorship of NASA, the National Institutes of Health, and the National Academy of Sciences. Dr. Lloyd V. Berkner, chairman of the NAS-Space Science Board, was general chairman. Approximately 500 medical and technical observers attended the day-long conference, including representatives of the Soviet Union, Hungary and Yugoslavia.

The conference was an effective contrast to the lack of data released on the Apr. 12 orbital flight of Soviet Maj. Yuri Gagarin. It included full details of Shepard's physiological responses before, during and after his flight. In addition to the vital responses of temperature, pressure and respiration, NASA provided a microscopic analysis of the astronaut's blood, urine, serum and plasma enzymes before, during and after his flight.

Biochemical data on Redstone-profile centrifuge runs were compared with post-flight microscopic analysis. The major conclusion was that Shepard "appears to have paid a very small physiologic price for his journey."

Adrenal gland plasma, called norepinephrine, jumped from a pre-flight 5.2 count to 12.9 in a shipboard measurement made 30 min. after landing, which indicated response to stress. Measurement 30 min. after a Redstone centrifuge profile went up only 3.5 counts. Other than this area, however, Shepard's centrifuge and flight blood summaries appear consistent.

Examination made 45 hr. after the flight shows little change from measurements taken after centrifuge runs and the MR-3 flight.

Cdr. Shepard lost three pounds during the flight, which Dr. Carmault B. Jackson, Jr., said was in body water. This is attributed largely to the time spent in the capsule—about 4.5 hr.—and the fact that Shepard did not vent his pressure suit for some time after he reached the USS Lake Champlain. Long time in the suit may account for a 1-deg. temperature rise between launch and shipboard examination.

Robert R. Gilruth, director of the Space Task Group, said the MR-3 flight served to demonstrate the skill with which the Mercury ground training devices have been developed, but he said it is much too early to make a decision on whether astronaut training can be conducted exclusively on the ground.

Cdr. Shepard, who said the astronaut training program can be shortened "by quite a degree," identified as the most important training areas:

- **Human centrifuge** at Johnsville Naval Air Development Center, which provides control tasks similar to those experienced in flight with computer control. Runs provided training on muscle control for circulation and breathing, voice transmission and attitude control.
- **Procedures trainers** at the Space Task Group, Langley Field, and Atlantic Missile Range. Devices correlate preflight training, provide mission simulation and practice in operational techniques.
- **Spacecraft testing** by the astronaut in the capsule he will pilot. This allows the astronaut to "learn the language of the blockhouse" and to determine the idiosyncrasies of the various systems.

Training which probably will be eliminated for the remainder of the Mercury program, and may be curtailed in later astronaut training programs, includes desert survival and weightless flights in aircraft.

Effect of the aerodynamic buffeting experienced when the Redstone and capsule went through the maximum dynamic pressure phase was an area on which the pilot and medical observers failed to agree. Dr. Jackson and Dr. C. Patrick Laughlin, both of the Space Task Group aerospace medical branch, said Shepard was unable to read his instrument panel for about 15 sec. during this period.

Cdr. Shepard, who said he felt the buffeting and vibration for 15 sec., said his vision was not completely blurred at any time, and he could discern panel lights.

The astronaut said the phenomenon is not a problem. Buffeting will be reduced by a newly-designed booster-capsule clamp ring faring, and vibration transmitted to the pilot's helmet will be decreased by placing more padding under the helmet.

Other major phases of the MR-3 mission discussed included:

- **Preflight preparation,** discussed by Christopher C. Kraft, Jr., assistant chief of the Mercury flight operations division, who said 40 simulated profiles were run at the Mercury control center during the eight-month period preceding MR-3. Atmospheric conditions prevented high frequency radio reception during the MR-3 flight, although the equipment probably was functioning

Mercury Net Test

Washington—Mercury tracking network will be tested early in August when a Blue Scout is scheduled to orbit a payload containing 104 lb. of Mercury capsule instruments.

Air Force Blue Scout will be used to launch the payload because it is the vehicle most readily available. The orbit will be programed over the 17-station network to repeat a portion of the Mercury-Atlas 3 mission, which failed Apr. 25 (AW May 1, p. 30). This single-orbit Atlas mission is scheduled to be repeated in early August.

Next manned Mercury-Redstone ballistic flight is now scheduled for mid-July, and the third two months later. Three-orbit chimpanzee flight in the fifth Mercury-Atlas is planned in early September. If these flights are successful and on schedule, the manned orbital flight could be flown in early October.

Mercury Launch Weight

Washington—Launch weight of the Mercury-Redstone 3 capsule certified to the Federation Aeronautique Internationale for ballistic space flight record (AW May 15, p. 29), was 4,040 lb., considerably more than the weight previously given.

The new figure was made public last week by Aleck C. Bond, assistant chief of flight systems division at the Space Task Group, during the medical conference on the Mercury-Redstone 3 manned ballistic flight. National Aeronautics and Space Administration had said the capsule weighed about a ton.

Launch weight includes a 900-lb. escape tower which is jettisoned after booster staging. Landing weight excludes the antenna canister housing, retropack and hydrogen-peroxide reaction fuel.

NASA declined to compare weight of the MR-3 capsule with weight of the Atlas-boosted orbital capsule on the grounds that it would reveal performance capabilities of the Atlas weapon system.

New Titan II Stage

Washington—New high-energy, third stage rocket will be developed by the Air Force for use on the Martin Titan II "to meet the joint requirements of National Aeronautics and Space Administration and the Department of Defense," according to Deputy Defense Secretary Roswell L. Gilpatric. One use will be as a backup for the Atlas-Centaur vehicle in the Advent communications satellite program (AW June 5, p. 26).

Gilpatric last week told the Senate Aeronautical and Space Sciences Committee that the new upper stage may use something besides the hydrogen-oxygen combination utilized in Centaur stage, possibly including storable propellants "which would make it more useful than the Centaur for special missions involving, for example, restarting the engine at infrequent intervals to keep a payload in a particular orbit."

Aviation Week has learned that propellants being considered also include liquid hydrogen-liquid oxygen combination and fluorine and liquid oxygen. If an Agena is used for Titan's upper stage, it will be a later model than either the existing Agena B or the Agena C now under development.

properly. Control center heard a tone, but no voice.

• **Biomedical systems,** discussed by Lt. Col. Stanley C. White, chief of the Space Task Group's life systems division. Re-entry accelerations of 20-25g can be experienced by the astronauts without harm. Shepard's peak re-entry force was 11g. The impact skirt was adopted to attenuate longitudinal accelerations to a force of less than 20g. Lateral force with the skirt will not rise above 10g. The aluminum honeycomb structure under the pilot couch is 6.5-in. thick and can be compressed to a 2.5-in. thickness in cushioning a ground landing. Head restraint was found unnecessary.

• **Preflight and postflight** medical examinations, reviewed by Dr. Jackson. Requirement was emphasized to get more data regarding the effects of diet, 100% oxygen environment, activity and body position on biochemical assays. Shepard had a patch of irritated skin from biosensor paste, and the sensors were moved 1.5 in. away from tatoo reference marks on his chest. Preflight psychiatric examination found him relaxed, cheerful, alert, enthusiastic and able to discuss his coming mission and its hazards realistically. Biochemical specimens were collected and frozen at Grand Bahama 3 hr. and 45 hr. after the flight and flown to laboratories for micro-analysis.

• **Bio-instrumentation,** discussed by Lt. Col. James P. Henry, chief of the Space Task Group's aerospace medical branch, who hopes some of the Mercury sensors will find clinical application. Rectal thermistor was chosen as the most definitive means of measuring body temperature. Respiration was measured with a thermistor in the helmet microphone, and four cups were attached with electrode paste to the chest, back and left side to measure heart beat. Blood pressure was not monitored during the flight, but active work is under way to incorporate an AiResearch Corp. unidirectional microphone into the Mercury pressure suit to take this measurement during orbital flights.

• **Physiological responses,** discussed by Dr. Laughlin, who also reviewed the environmental and stress parameters during the flight. Cabin pressure was stable at 5.7 psia.; cabin air temperature ranged from 93 to 111F; suit temperature from 71 to 80F; g-loading at launch was 6.2, and it reached 11 during re-entry; 4g load was experienced when the main parachute deployed at 10,600 ft.; weightless flight time was 5 min. 4 sec., interrupted by a 23-sec. retrofiring period.

Baseline data for the flight was obtained from 17 Redstone g-profiles made by Shepard. Peak pulse of 138 beats/min. was reached during launch, and it dropped to 108 just before re-entry. Thirty seconds after re-entry, it was 132. Shepard's normal pulse rate is 70 beats/min. Respiration rate peaked at 40, also during the launch phase, returned to a norm of 20 breaths /min. during flight, and fluctuated up to 30 during re-entry. Heart activity, voice transmission and eye movement were normal throughout the flight.

• **Pilot performance,** discussed by Dr. Robert Voas, head of the Mercury training office. Dr. Voas summarized results obtained from the on-board camera, flight voice tape and capsule attitude record to conclude that Shepard's performance was comparable to the quality of a simulated mission under optimum conditions on the procedures trainer, despite the 110 separate functions he performed during his flight.

Aerojet-Westinghouse Team Wins Contract for Nerva Engine Study

Washington—Team of Aerojet-General Corp. and Westinghouse Electric Corp. has won a contract for the design study phase of the Nerva nuclear engine.

Negotiations for the contract, to total about $2 million, began last week between the two companies, the National Aeronautics and Space Administration and the Atomic Energy Commission. Westinghouse is expected to be assigned responsibility for the reactor, with Aerojet working on non-nuclear components.

Joint NASA-AEC Space Nuclear Propulsion Office has indicated a desire to keep the same team throughout the development life of the Nerva project, expected to last until 1967 and cost several hundred million dollars (AW May 22, p. 30).

The Aerojet-Westinghouse task, to be completed in six months, calls for design of the Nerva engine, acting as consultant to the Los Alamos Scientific Laboratory during the Kiwi-B test series, preparing a master plan on system development and costing to meet a 1965-66 flight date, and conducting research and development in critical engine component areas.

Other companies which submitted Nerva proposals Apr. 2 are American Metal Products, General Electric Co., Pratt & Whitney Division of United Aircraft Corp., Rocketdyne Division of North American Aviation and Thiokol.

The Nerva program is the only current plan for nuclear space propulsion hardware, but the unsuccessful bidders look for parallel or backup Defense Department nuclear rocket programs to reopen the nuclear rocket market.

Kiwi-B nuclear ground development engine tests will begin in October and will be conducted at two-month intervals, according to the present schedule. First tests will use gaseous hyrogen as propellant, and liquid hydrogen as nozzle coolant. First test using liquid hydrogen as propellant is planned early next year.

French Satellite Study

Hughes Aircraft and Compagnie Francaise Thomson Houston have undertaken a joint study to determine feasibility of adapting the Hughes-developed communication satellite to French-European needs. Present thinking is that a single satellite in equatorial orbit at zero degrees longitude could provide voice relay between most of West Europe, Africa, the Middle East and the French possessions in the West Indies. Hughes has proposed a 33-lb. satellite which could be launched by a Scout-type vehicle from Jarvis Island in the Pacific Ocean. Hughes, which developed the satellite with its own funds, was one of the unsuccessful bidders in National Aeronautics and Space Administration's recent Project Relay competition.

NASA Using PERT In Program Planning

Washington—Modified PERT/PEP management system has been adopted by the National Aeronautics and Space Administration, using computer analysis to prepare time and fiscal situation reports on the civilian space program.

D. D. Wyatt, formerly assistant director of NASA's space flight programs for planning and coordination, has been appointed director of the new Office of Programs which will administer this new management function.

The system stems from the Navy's program evaluation review technique (PERT) and Air Force program evaluation procedure (PEP) which is being adopted widely in government and industry (AW Nov. 28, p. 85).

Method essentially involves determining the longest sequence of events, called the critical path, necessary to meet time and funding schedules.

Wyatt will report to Dr. Robert C. Seamans, Jr., associate director, and will be the management's top budget adviser. In Wyatt's organization will be four directorates: project review, headed by William Fleming, resource programing, which Wyatt heads in an acting capacity; management reports, headed by Thomas E. Jenkins, and facilities, headed by Ralph E. Ulmer.

In organizing the new office, NASA Administrator James E. Webb also shifted the Business Administration Office, directed by Albert F. Siepert, from a line to a staff function and changed the name to Office of Administration. Siepert continues to report to Dr. Seamans in directing the agency's fiscal and administrative functions.

Wyatt's responsibilities will be program budgeting and reprograming, annual budget review, review and coordination of project development plans, coordination of facilities planning and construction, and program progress report preparation.

Saint Study

Study contract for detection equipment that would be used in operational Project Saint rendezvous and inspection satellites is expected to be awarded by the end of June by Air Force Special Weapons Center, which has management responsibility for development of this equipment.

Critical job will be to determine whether an unidentified, potentially hostile satellite under scrutiny by a Saint vehicle contains a nuclear weapon, either armed or unarmed. Radio Corp. of America is prime contractor for the Saint vehicle and general payload in the research and development phase.

BELL AEROSYSTEMS CO. rocket belt carries engineer **H. M. Graham** on flight test. Graham has flown distances up to 360 ft., and to hilltops 30-ft. high. Funded by Army Transportation Research Command since Aug. 1960, concept dates from 1954.

SRLD (Small Rocket Lift Device) belt uses hydrogen peroxide as propellant, catalyzed to decompose into steam and exhausted through two lateral nozzles. Jet deflectors control yaw; body motion controls pitch and roll. Present belt is feasibility model.

Commercial Satellite Owner Limits Will Be Reconsidered by FCC

By Philip J. Klass

Washington—Federal Communications Commission has agreed to reconsider its earlier action in excluding non-common carriers from any joint venture satellite communication system, as requested by General Electric's Communication Satellites, Inc., and is expected to reach a decision later this month.

Interested companies have been invited to submit their comments on the GE petition by June 14, after which GE will have until June 19 for its rebuttal (AW June 5, p. 39).

The commission then is expected to set up an ad hoc committee, consisting of representatives of interested communication common carriers and government agencies, in an effort to develop plans and a program for the joint venture. Question of whether aerospace companies, such as GE and Lockheed, will also be represented on the ad hoc committee currently is undecided.

The majority of communication common carriers present at FCC's June 5 industry conference on satellite communication systems agreed with the commission's earlier announced view that non-common carrier companies be excluded from ownership.

Common carriers expressed these views:

- **American Telephone** & Telegraph Co. said it "fully accepts the conditions which the commission has indicated it will impose on any joint venture . . . we believe that the commission's First Report defines a framework of safeguards which should fully serve the public interest."
- **RCA Communications, Inc.** said it "wholeheartedly supports the conclusions of the commission in its First Report."
- **International Telephone** & Telegraph Co. and Radio Corporation of Puerto Rico favor an ad hoc committee consisting solely of common carriers, a spokesman said.
- **Tropical Radio Co.** representative said the satellite communication system "should be a common carrier and only a carrier operation."
- **Hawaiian Telephone Co.** said it "favors a joint venture only with other common carriers."
- **Western Union** said it "generally agrees with the statements of the other carriers."

Justice Department representative John James said that the department concurs with the FCC "that a joint venture which is consistent with anti-trust laws offers the best available method of achieving . . . a workable system at the earliest possible date."

However, James added that "as the plan for joint action is developed, we urge that the commission consider the desirability of expanding the base of ownership of the satellite communication system. We believe that a further expansion of ownership and participation in the joint venture will reduce the possibility . . . [of control] by a single company and that a wider diversity of ownership will promote research and development in the satellite communications field."

James was asked by FCC Commissioner Robert T. Bartley ". . . if the commission should determine that the base should not be broadened as a policy matter, is it the judgment of the Department of Justice that [new] legislation would be necessary?" James replied: "I would like to see the plan first, but I think it could be worked out so that it would be acceptable."

This was seen as a softening of an earlier expressed Justice Department view which indicated that ownership participation by non-common carriers was one of four criteria needed to meet anti-trust laws.

Joseph B. Kittner, General Electric counsel, said that the FCC's plan to exclude non-common carriers raised the question of how far the commission could go without public hearings in amending its rules.

Both GE's Kittner and Lockheed's Beardsley Graham asked that their companies be represented on the ad hoc committee which FCC is expected to establish.

Kittner said that unless a separate, clearly defined entity is created to own and operate a satellite communication system, it might be difficult for the commission to accurately determine the capital investment and operating costs involved to establish fair rates for services.

Additionally, he said, a plan such as that proposed by AT&T would raise questions of how decisions would be made and how the system would be managed to prevent AT&T domination.

Earlier, AT&T's James E. Dingman said that his company regards its previously submitted engineering and ownership proposals "as a basis for discussion and not . . . a fixed position on our part."

Defense Budgeting Difficulties

Defense Secretary Robert S. McNamara's computer exercise to wring significant savings from the operational side of the military budget to make room for more procurement is falling short of its objectives, in the opinion of economist Eliot Janeway.

The result, Janeway believes, will be a package calling for $5-10 billion in production money for limited war procurement tied together with higher taxes and price and wage controls.

McNamara—and the Kennedy Administration—had hoped to save $4 billion, Janeway said. At most, by eliminating the National Guard, savings might total $2½ billion, the economist believes, but the final result more probably will be no more than $1 billion. The Administration will thus seek higher income taxes and excess profits taxes, Janeway said, to provide the difference between the program cost and the savings effected.

The economist, who developed the Defense Cycle theory in his studies of economic mobilization, commented in a recent speech to the Boston Society of Security Analysts on the forthcoming defense build-up:

"So far as the economy is concerned, the impact it will have threatens to deflate values and to squeeze earnings. This defense build-up has not yet begun, but time has already run out on the old era assumption that bad news from abroad and big numbers from Washington automatically mean good news for the economy.

"While business activity is eventually bound to speed up with defense spending—especially in an atmosphere suggesting emergency—higher net earnings and higher values do not necessarily result from higher activity. Higher net earnings and higher values are unlikely to result from the particular kind of defense stimulus in prospect now."

Unlike the Korean build-up, Janeway said, the deflationary effects of emergency taxes and controls will be felt before emergency spending exerts any inflationary effect.

"As a matter of fact," he said, "the present seasonal recovery in business activity will give way to another siege of drag and sag months before activity is spurred by any new defense stimulus."

Janeway noted that the most vulnerable stocks to deflation are high-priced electronic and scientific companies which have had little or no earnings and thus have built no excess profits tax base.

Sufficient Data Predicted by 1964 For Liquid-Solid Booster Choice

By George C. Wilson

Washington—Relative merits of liquid and solid propellants for big boosters should be clear enough by 1964 to enable the Defense Department to make a choice, according to Deputy Defense Secretary Roswell L. Gilpatric.

Gilpatric told the Senate Aeronautical and Space Sciences Committee that the "solid propellant is simpler and may well be more reliable" but it requires considerable testing before a judgment can be made. The group began hearings last week on legislation to authorize more money requested for space programs.

He said that "about 1964" the Defense Department should be able to determine whether liquid or solid propellants hold the greatest promise, "particularly in Nova." Air Force is to get $50 million for solid booster development and $12 million for static test facilities.

Gilpatric's time estimate came during an exchange with Sen. Stuart Symington (D.-Mo.) who complained that while he was in the Defense Department "nobody made decisions" on the relative merits of weapons. "Everybody was ready to go into manufacturing."

Observing that the military services have "no specific requirement" today for large, solid boosters, Gilpatric said: "It would not be safe for this country to rely on a single approach. We would be putting all our bets on one system." He also said ultimately the military may need the solid boosters it will develop initially for the National Aeronautics and Space Administration man-in-space program.

Gilpatric discussed these other factors:

- **Atlas Centaur** probably will not be powerful enough to launch the 1,250-lb. Advent communications satellite, so a modified Titan II, capable of launching a 2,000-lb. payload, may be used instead or as a "backup" (see box).
- **Defense Department** will test a solid fuel engine of 2 to 3 million lb. thrust by 1964. Gilpatric noted Aerojet's solid fuel engine developed 500,000-lb. of thrust in a recent test.
- **He is "satisfied** without question" with the President's decision to give NASA the major responsibility for space programs.

Nuclear Promise

At the same time, Chairman Glenn T. Seaborg of the Atomic Energy Commission said nuclear propulsion holds the greatest promise for sustained space flight. He said the "basic problem" in its development at the moment is finding materials capable of withstanding the high temperatures in the reactors. Seaborg said it is his "realistic estimate" that the U.S. will have a nuclear vehicle qualified for manned flight "within a decade," adding that before that there will be flight tests—probably in the 1965-67 period.

Seaborg said he is "confident" fallout problems from nuclear spacecraft can be "satisfactorily solved."

NASA Administrator James E. Webb told the Senate space committee that the President's money requests constituted "a hard-hitting, well-rounded national space effort." Committee Chairman Robert S. Kerr (D.-Okla.) said the need was for a "unified, national program." The committee will continue its study of the President's space budget requests this week.

The House is expected to delay action on the President's requests until after the Senate passes its bill. Then the House Science and Astronautics Committee may hold additional hearings on the space bill.

Last week, the House passed a bill appropriating $1.2 million to NASA, $35.3 million less than President Kennedy requested after reviewing the Eisenhower Administration budget, and $584.3 million less than the Administration's total space requests, including those in his second State of the Union message (AW, June 5, p. 26). The House Appropriations Committee in its report said the money it recommended "is, in effect, the first payment on the programs of this agency for next year." The cuts included $27.54 million for research and development, $4.94 million for salaries and expenses and $2.82 million for construction and equipment.

Atlas Coffin Firing Fails

Vandenberg AFB—First Atlas E ICBM attempted to be launched from the West Coast exploded with a series of detonations on its pad here last week almost immediately after ignition. There were no casualties.

It was the first attempt to launch the missile in a straight research and development operation from a semi-hard "coffin" installation—an operational systems test facility completed last month at a total cost of $2.2 million.

Flight of the missile had been projected for more than 4,000 mi. over the Pacific Missile Range. The launch was being conducted by Personnel of the Air Force's Ballistic Systems Division and Convair. Strategic Air Command personnel were observing.

The operational suitability test facility was an operational prototype of the semi-hardened complex. It's purpose was to confirm the operational compatibility of all component systems—missile, launch procedures and ground support facilities.

Aerojet Fires Solid Three-Segment Motor

Firing of a 470,000-lb.-thrust, three-segment solid motor for 40 sec. last week marked the third program milestone in Aerojet-General's development of large solid propellant boosters for the Air Force. The full-scale, 55-ton motor—100 in. in diameter, a little less than 30-ft. long and containing about 50 tons of polyurethane propellant—was identical with the solid space booster recently proposed by Aerojet to several governmental agencies (AW Apr. 24, p. 87), but was volumetrically loaded less than the normal 80%.

Fourth step in the program, scheduled soon, is reported to be the firing of another 100-in.-diameter three-segment motor for 60 sec., developing 333,000 lb. thrust. Test of the fifth and final 100-in. three-segment motor, scheduled for later in the year, has not yet been defined.

First two firings in the present program took place on Jan. 26 and May 9 with 65-in.-diameter subscale motors. The first was a one-piece motor, weighing about 20 tons; it developed about 400,000 lb. thrust for 20 sec. The second motor comprised two segments, weighed about 25 tons and developed about 180,000 lb. thrust over 60 sec.

Army Research

Washington—Research Analysis Corp. was formed here last week in anticipation of assuming the Army operations research work being done by Johns Hopkins University's Operation Research Office. Chairman and president is Dr. Hector Skifter, and trustees chosen so far include Dr. Hendrik Bode, retired USAF Maj. Gen. James McCormack, Jr., retired Army Gen. Omar Bradley and John T. Connor. Army has notified Johns Hopkins that its contract will not be renewed and is seeking a non-profit firm that can take over ORO's facilities and personnel and expand to handle more short- and long-range work. ORO has concentrated on mid-range operations research.

Joint Approach to Be Emphasized With Similar Mission Aircraft

By Craig Lewis

Washington—Defense Department expects to emphasize the tri-service approach in the future for similar aircraft missions that would not require production runs large enough to justify multiple development programs.

Deputy Defense Secretary Roswell L. Gilpatric last week predicted early decisions on two aircraft being launched under this approach—the tri-service tactical fighter and the VTOL transport—and said: "We think for a number of future aircraft types, where we don't envisage a large enough production run to justify multiple designs for aircraft performing the same mission, that we will be able to work out the developments on a tri-service basis."

Gilpatric said "real progress has been made in narrowing the differences between the Navy and the Air Force on the characteristics for a tactical combat fighter," and that "we feel before very long we will have a definite decision on that."

If Defense should decide to develop separate tri-service fighters—one for the close support and another for the air superiority - interdiction - reconnaissance roles—Gilpatric indicated that the two programs could be assigned to separate services. In this case, the Air Force, which has $55 million budgeted for the fighter project, would seem the likely candidate to develop the high performance air superiority fighter, with close support type going to Navy.

Navy and Army want a simple, easily operated attack aircraft which can be bought in large numbers for close support. If Defense decides to develop a separate fighter-bomber for this role, the Navy Douglas Missileer, recently canceled, might stage a comeback. Earlier this year, the Navy took care to explain to the House defense appropriations subcommittee that Missileer had definite capabilities for furnishing air support for Marine Corps operations, including subsonic speed, easy maintenance and 1,500-ft. takeoff.

Gilpatric pointed out that Navy-Air Force differences are over such requirements as carrier compatibility and ferry range. He said any design must meet Army and Marine requirements. The Army thinks two separate fighters are needed, and for an interim solution, former Army Research and Development Assistant Secretary Richard S. Morse told Congress he favors an aircraft like Navy's Douglas A4D.

Gilpatric also said:

• **Proposed combining** of elements of Tactical Air Command's Composite Air Strike Force with Army's Strategic Army Corps forces is still under consideration by the Joint Chiefs of Staff.

• **Defense intelligence** reorganization plan is being delayed until the Pentagon sees what retired Army Gen. Maxwell Taylor recommends to the President in his report on the national intelligence system.

Air Force Considers New Contract Rules

Washington—Air Force is considering establishing new performance yardsticks in its research and development contracts.

Joseph V. Charyk, USAF undersecretary, reported to the House Appropriations subcommittee on the armed services that present cost-plus-fixed-fee arrangements "really reward the wrong things. If a much larger effort is marshaled than is really necessary, the rewards to the contractor are greater. There is no particular penalty if he fails to perform within this type of contract." Charyk outlined this Air Force position to the subcommittee:

"We have got to set up a new mechanism for handling research and development programs and I think that this does become possible . . . through the use of new computing machine methods to achieve a yardstick by which performance can be measured. . . . If we can reward and penalize on the basis of whether he does accomplish the job as proposed or whether he fails to do it or requires much more manpower to do it, I think we can begin to get at the roots of this problem."

USAF is now reviewing an advisory report by a "Systems Management Study Committee," appointed for the dual purpose of reducing costs through contract and management improvements and shortening lead-time, particularly on missile and space projects.

Headed by Gen. E. W. Rawlings, retired former commander of Air Materiel Command, the committee included: Dr. William O. Baker, vice president, research, Bell Telephone Laboratories; Dr. C. S. Draper, director, Instrumentation Laboratory, Massachusetts Institute of Technology; C. L. Johnson, vice president, advanced development projects, Lockheed Aircraft Corp.; V. G. Nielsen, former executive, Thompson Ramo Wooldridge and Hughes Aircraft Co.; and Gen. Orval R. Cook, USAF (ret.) president of Aerospace Industries Assn.

News Digest

First test of the complete second stage propulsion system for the USAF-Martin Titan II was made at Martin's Denver plant last week. First test of the complete first stage propulsion package probably will take place when first missile is captive tested there. Aerojet makes the engines for both stages. Seventy-foot first stage develops 430,000 lb. of thrust; 22-ft. second stage develops 100,000 lb.

Air Force last week launched an Aerobee-Hi rocket to an altitude of 101 mi. in an attempt to trap micrometeorites on a series of electron microscope leaves. Payload was recovered after the flight from White Sands Missile Range.

Maj. Yuri Gagarin has received a gold medal from Federation Aeronautique Internationale for his orbital flight.

Dr. Marvin Stern, former assistant director of the Office of Defense Research and Engineering for strategic weapons, has become deputy director for weapon systems. Dr. Eugene G. Fubini, head of the directorate for research, becomes deputy director-research.

Saturn launch Complex 34 at the Atlantic Missile Range was accepted by the National Aeronautics and Space Administration from the Corps of Army Engineers last week. Break in the lock at Wheeler Dam, however, may put first use of the $43-million facility behind schedule. Saturn booster is to be shipped by barge down the Tennessee, Ohio and Mississippi rivers. The break at Wheeler is about 50 mi. down the Tennessee from Huntsville, Ala.

Lt. Gen. M. V. Khrunichev, chief of the Soviet State Committee on Coordination of Scientific Research (AW June 5, p. 88), died early this month, Soviet news agency Tass reported. Khrunichev last month had been given sweeping powers to reorganize the entire Soviet research effort. Conference will be held at the Kremlin June 12-14 on results of the reorganization.

Beech Aircraft Mach 2 target drone XKD2B-1/Q-12 was successfully launched last week from the Naval Missile Center, Pt. Mugu, Calif. The expendable target will be operational by October, 1962, and is the result of a joint USAF/Navy R&D effort.

Merger discussions between Republic Aviation and ACF Industries have been called off, according to officials of both companies.

MATS Awards $76.6 Million in Contracts

14 carriers chosen for domestic, overseas airlift; CAB approval required but appears far from certain.

By David H. Hoffman

Washington—Military Air Transport Service has named 14 U. S. airlines to receive $76,631,875 in Fiscal 1962 overseas airlift, Logair and Quicktrans contracts. But each award is subject to Civil Aeronautics Board approval, an approval that now seems far from certain.

Concerned with whether the hot competition for contracts resulted in "uneconomic" bids, CAB last week promised "to take a hard look very promptly" at MATS' proposed purchase of commercial airlift. In doing so, it will consider complaints that several successful bidders sharply undercut minimum passenger and freight rates set by the Board.

For the first time since 1953, CAB will pass on the economics of domestic as well as overseas service furnished MATS by U. S. airlines in the coming fiscal year. By repealing Part 294 of its Economic Regulations, under which blanket exemptions have been granted to domestic contractors, the Board acquired authority to reject bids quoted MATS by all except uncertificated and some international flag carriers. Repeal of Part 294 became effective on May 11; MATS' request for proposals was distributed to the industry during the first week in May.

CAB Interest

CAB's interest in the impact military procurement policies have on commercial airlines has brought the Board into conflict with Department of Defense on several key issues.

For example, Defense feels that the airlines should not have to petition CAB for specific operating authority, or exemptions from tariffs, to perform military charters. Similarly, Defense has acted against or opposed in writing the Board's minimum rate policies, the Board's legislative effort to gain some economic control over the so-called Part 45 operators and the Board's stand that only certificated airlines should be eligible for MATS' contracts.

Of the total MATS award, $48,371,545 represents overseas airlift. The remainder is divided between Logair, $21,797,334, and Quicktrans, $6,462,994, with the entire Quicktrans award going to Slick Airways. Six carriers—World, Alaska, AAXICO, Zantop, Capitol and Riddle—have been selected to share the Logair contracts, two more than in Fiscal 1961 when AAXICO and Alaska were not included.

Contracts for "outsize cargo" service, intra-Alaska service and ballistic missile base support still are being negotiated. When these awards are made by MATS, total value of the Fiscal 1962 contracts probably will exceed $85 million. Should CAB reject bids that undercut its various rate floors, thus forcing MATS to renegotiate or to fall back on alternate proposals filed by the carriers, this total will then climb higher.

Airline satisfaction with the volume of business to be allotted in Fiscal 1962 was tempered somewhat by Defense hints that in subsequent years the value of such business might drop. Increased emphasis on preparation for limited war could change the ratio between MATS civil-eligible traffic and hard-core traffic, which must move by military aircraft. This ratio is determined annually by the Joint Chiefs of Staff.

In general, no contracts will be signed until approved by CAB, the Secretary of the Air Force and MATS' Airlift Capability Survey Committee, which will weigh the ability of each airline to perform its commitment. In addition, overseas airlift awards are subject to a MATS-airline agreement on schedules, while domestic awards are contingent on the availability of funds and aircraft.

Airline Criticism

Although most interested airlines conceded that the current proposal requests were both clear and logical and that the bidding process was managed ably by MATS, they also criticized these aspects:

- **Awarding of contracts** to carriers that had not allocated any, or else very few, aircraft to the Civil Reserve Air Fleet.
- **Awarding of contracts** to uncertificated carriers over which CAB has no jurisdiction. Although only one such airline, Zantop, was selected as a contractor last week, there were 38 others eligible to bid. Largely because these Part 45 uncertificated airlines need not obtain CAB exemptions, certificated airlines feel they offer unfair competition in the bidding for MATS' contracts.

MATS Fiscal 1962 Airline Contracts

Carrier	Contract	Transports To Be Used	Operating Category	CRAF Fleet*
Pan American	$15,926,194.88	707, DC-8	International	86 (707, DC-8, DC-7, DC-4)
Flying Tiger	10,170,064.78	CL-44	All-Cargo	12 (1049H)
Slick	8,878,964.29	1049, CL-44, DC-6A, C-46	All-Cargo	6 (1049HS and 1 DC-4)
AAXICO	7,786,764.00	DC-6A	All-Cargo	None
Riddle	6,991,978.87†	C-46, DC-7CF	All-Cargo	7 (DC-7CF)
Seaboard World	6,135,777.66	1049, CL-44	All-Cargo	8 (1049H)
World Airways	4,971,463.80	DC-6A, 1049H	Supplemental	13 (1049H, DC-6A, DC-4)
Alaska Airlines	3,430,051.34	DC-6C	Alaskan Scheduled	2 (DC-6A)
Overseas National	3,052,986.48	CL-44	Supplemental	3 (DC-6A)
Capitol Airways	2,562,869.31	C-46	Supplemental	1 (1049H)
Southern Air Transport	2,338,362.00	DC-6	Supplemental	2 (DC-6A)
Zantop Air Transport	1,564,584.91	C-46	Uncertificated	None
Trans International	1,440,831.60	1049H	Supplemental	4 (1049H)
Northwest	1,380,981.72	DC-6	Trunkline, International	10 (DC-8, DC-6A)

* Listing of aircraft allocated to the Civil Reserve Air Fleet, revised in April, will be amended substantially July 1 to reflect transports assigned or promised by airlines bidding for the above contracts.

† Riddle's tentative award, which includes a $3,329,906 Logair contract and a $3,662,072 overseas airlift contract, does not include approximately $8 million that Military Air Transport Service is expected to award the carrier to haul outsize cargo over domestic Logair routes.

Electra Lawsuits May Mean Higher Manufacturers' Insurance Rates

Los Angeles—Outcome of the many lawsuits filed by the survivors of passengers killed in the crashes of two Lockheed Electra turboprop transports may have far-reaching effects throughout the aircraft industry.

Comptrollers of major West Coast airframe manufacturers have told AVIATION WEEK they fear that much higher premiums for liability coverage may be asked by insurance companies in the event of large dollar awards to the plaintiffs. Corporate legal staffs are closely watching the progress of the trials because present law, they feel, does not clearly define a practical limit to a manufacturer's liability.

A recent ruling by California Superior Court Judge Frank S. Balthis in Los Angeles denied a demurrer filed by Lockheed attorneys in a $500,000 suit brought against the company, Allison Division of General Motors and Northwest Airlines. The suit, presented by Myron L. Garon, a lawyer representing the family of a man killed with 62 others in the Northwest Electra that crashed near Tell City, Ind., on Mar. 17, 1960, alleged breach of express and implied warranty and negligence. In the demurrer, an action by the defendant denying that the plaintiff's claims have a valid basis for legal proceedings, Lockheed's lawyers said that privity—direct connection—does not extend from the aircraft manufacturer to the airline passenger. Warranty, they contended, applies only to the aircraft purchaser—Northwest Airlines.

In ruling against the demurrer, Judge Balthis said that his decision had a precedent in the Peterson Case in 1960, in which the California Superior Court ruled that a workman injured by a defective grinding wheel had recourse against the wheel's manufacturer.

Lockheed declined to comment on the ruling, but Garon said that the next step would be a consolidation of several similar suits by the court in July. The defendants will then file an answer to the charges of breach of warranty.

Liability insurance involves considerable negotiation, with low rates predicated upon past performance. Therefore, if the courts decide against Lockheed and Allison, premiums will undoubtedly skyrocket.

In the two accidents, attributed to structural failures induced by severe propeller whirl modes (AW Mar. 6, p. 38), a Braniff Airways Electra crashed near Buffalo, Tex., on Sept. 29, 1959, with a loss of 34 lives.

Flying Tiger Lease

Flying Tiger Line, which must re-equip its ground facilities to cope with a fleet of Canadair CL-44 freighters, will lease two of the 10 aircraft it has on order to Overseas National Airways for at least a year.

The two CL-44s slated for Overseas National include N447T, which would have been delivered to Flying Tiger this month, and N452T, which would have followed in September. These CL-44s are probably the second and fourth aircraft of the Flying Tiger order.

By leasing the 205,000-lb. gross weight turboprop transports, Overseas National was able to win a $3,052,986 Military Air Transport Service contract for Fiscal 1962.

Concurrently, Flying Tiger helped solve the excess capacity problem that probably would have resulted from the introduction in quick succession of the 10 large freighters. Flying Tiger already has received one CL-44 (see p. 40), with at least one more expected this month. The carrier's first CL-44 common carrier operation over domestic U. S. routes is scheduled to begin Oct. 1.

CAB Examiner Rejects Qantas Tahiti Request

Washington—Civil Aeronautics Board examiner has asked the Board to deny an amendment to Qantas Empire Airways' foreign air carrier permit authorizing Tahiti as an intermediate stop on its Australia-U. S. route.

Examiner Joseph Fitzmaurice, ruling on whether Tahiti is a point granted to Qantas under the terms of the U. S.-Australian bilateral agreement (AW May 22, p. 46), said that the right to serve a point in the U. S. and in a third country not a party to the bilateral agreement is not a "sovereign" right and the Board can reject the State Department's view that Tahiti is covered by the bilateral. The examiner also discussed these factors:

• **Tourist accommodations.** Tahiti has, at present, hotel accommodations for 850 persons. The airlines which already serve Tahiti face the prospect of having to turn away tourists for lack of accommodation, he said, therefore another carrier serving Tahiti would not serve any public purpose.

• **Competition** to South Pacific Air Lines. South Pacific's operations have shown an upward trend since April, 1960 that may make the carrier profitable. Authorizing Qantas to serve Tahiti would mean a $500,000 annual loss to South Pacific, which could cause bankruptcy.

• **Reciprocity.** Since there is no U. S. carrier authorized to serve a route comparable to the one sought by Qantas, there is no issue of reciprocity.

Vickers to Phase Out Vanguard Transport

London – Vickers-Armstrongs, Ltd. will phase out the Vickers Vanguard turboprop transport early next year after delivery of the 43rd aircraft to Trans-Canada Air Lines. Further orders are not expected.

As of last week, Vickers had built 20 Vanguards, seven for British European Airways and 13 for TCA, the only two purchasers.

Viscount Knollys, chairman of Vickers, Ltd., the parent company, warned of "intense competition for Vickers-Armstrongs, citing the large sums written off by U. S. air transport builders as an indication of financial risks taken in development of civil aircraft. He said the need for national backing of new civil aircraft development remains and added: "It is encouraging that in 1960 a more positive government policy began to take effect." British government is to aid development of the BAC 111 short-range jet transport.

Government aid also is expected for studies of a variable geometry aircraft, Viscount Knollys said. He referred to a contract from the Ministry of Aviation for a study of theory, aerodynamics and engineering experimental programs, plus building of a fuselage center section, two stub wings and a fore wing section in a period extending into 1962.

Atlantic Fare Cuts

New York—Group fares at reduced rates and extended-period excursion fares were major proposals under study here last week by an International Air Transport Assn. working group considering the North Atlantic fare structure.

The group fare reportedly would be offered to groups of about 35 people and would provide a 30-35% discount from the base fare. The excursion periods under discussion included a 21-23 day fare.

The IATA group will meet again next month in Europe. Its purpose is to consider the need for developmental and special fares and to study proposals. A point reportedly at issue in the recent meeting was how far into the peak season any special fares should extend.

If agreement is reached at the second meeting, a mail vote possibly could be taken of the IATA membership and it is possible that the Oct. 1 fare levels could be affected.

Most Airlines Favor Easing Rules For Critical Training Maneuvers

Washington—Majority of U. S. airlines represented by Air Transport Assn. last week favored easing the rules that require airline pilots to demonstrate critical maneuver while undergoing type rating and semi-annual proficiency flight checks.

In a "working paper" distributed at an industry-wide conference called by the Federal Aviation Agency, ATA indicated that maneuvers such as full instrument takeoffs, steep turns and in-flight shutdown of turbojet engines should be banned.

ATA emphasized, however, that the paper outlined the "majority airline viewpoint." It is not, as yet, representative of ATA's official stand on how pilot training requirements should be revised.

Purpose of the conference, according to Oscar Bakke, director of the FAA Bureau of Flight Standards, was to decide whether "we're asking for trouble" by holding to present type rating and proficiency check procedures. Bakke then referred to the fact that four of the five fatal U. S. accidents involving airline turbojet transports occurred during training or demonstration flights.

But Bakke also said: "we must penetrate deeply enough in training" so that any unusual flight characteristics of a transport, or any pilot difficulty in coping with them, are uncovered during check flights, not in scheduled service.

Detailed recommendations on how Civil Air Regulations and Civil Air Manuals governing pilot transition and proficiency checks should be amended were made by the Air Line Pilots Assn. Urging that the six-month proficiency checks be considered training flights designed to maintain pilot proficiency, ALPA generally favored retaining the maximum performance maneuvers at issue.

Here is how initial airline views, as expressed by the ATA, compared with those of the pilots:

• **Maneuvering with two turbojets** simulated out on the same side. Airlines favor the elimination of this check on rating and proficiency flights but its retention during initial pilot training. ALPA recommends that "50% power loss approach and landing" should be retained if marginal control properties of the particular aircraft have been eliminated during certification tests, the maneuver is first practiced at altitude, it is not hurried and tight turns at low altitude are always avoided.

• **Engine shutdown in flight.** Airlines urged that actual shutdown be accomplished only on propeller-driven aircraft. ALPA took no stand on whether turbojet shutdown and re-start procedures should be demonstrated on training flights.

• **Rapid descent and emergency pull-out.** This maneuver simulates a sudden air traffic control clearance to descend immediately over a navigational fix and

Iberia Air Lines Receives 3 Douglas DC-8s

Iberia Air Lines of Spain accepted delivery of three turbofan-powered Douglas DC-8 transports recently and announced plans to inaugurate transatlantic jet service on July 1. The three new Series 53 DC-8s, named after famous Spanish artists—Goya, El Greco and Velazquez—are configured to carry 28 first class and 94 economy class passengers. Service will be offered from New York direct to Madrid four times weekly. The DC-8s will be based and maintained at Barajas Airport in Madrid. Iberia still has four French Caravelles on order. The airline's seat capacity will be more than doubled with the addition of the jets on the North Atlantic run. Present capacity is 1,066 per month which will be increased to 2,232 per month. Jet service later will be extended to Mexico and South American routes which now are served by propeller-driven Super G Constellations.

Jet Accident Summary

Four turbojet transports have had fatal accidents while on U. S. training or associated flights. Only one turbojet transport has been involved in a fatal crash while carrying passengers over U. S. routes. Here is the summary:

- **Aug. 15, 1959: An American Airlines Boeing 707 crashed at Peconic, L. I., N. Y. on a pilot training flight, with five fatalities.**
- **Oct. 19, 1959: A Boeing crew flying a 707 on a customer demonstration flight crashed near Seattle with four fatalities.**
- **May 23, 1960: A Delta Air Lines Convair 880 crashed at Atlanta, Ga., on a pilot training flight with four fatalities.**
- **Dec. 16, 1960: A United Air Lines Douglas DC-8 collided with a Trans World Airlines Super Constellation over New York City on a scheduled flight. There were 136 fatalities, including those killed on the ground.**
- **Jan. 28, 1961: An American 707 crashed at Peconic, L. I., N. Y., on a pilot training flight with six fatalities.**

the 180-deg. climbing turn that might be required shortly thereafter. Airlines recommend the maneuver be dropped as a training requirement. ALPA believes that the so-called "Canyon Approach" provides worthwhile training in power coordination, instrument scanning and altitude and speed control. Pilots want to practice it at an altitude affording an "adequate safety margin" and with all engines operating.

• **Simulated loss of an engine** on takeoff. Airlines would rewrite the present regulation to read: "If it is consistent with safety, traffic patterns, local rules and laws, a simulated engine failure shall be experienced during takeoff and a landing shall be conducted simulating one engine inoperative." When "practicable," the engine would be lost before the aircraft reaches 300 ft. ALPA, reasoning that "it should be possible to conduct training in all maneuvers that can be expected to occur in flight without requiring an exceptional degree of skill, alertness or strength on the part of the pilot and without danger of exceeding the limit load factor" of the aircraft, also recommended this item be retained. But it qualified this position to the extent of maintaining that simulated loss of an engine on takeoff should be practiced only when favorable weather and runway conditions exist, and only after the maneuver has been performed both in a flight simulator and at altitude.

Discussing how training accidents are caused, ALPA told the conference that checks often are accomplished "in an atmosphere of economic pressure and in high-density areas with unrealistic procedures generated by noise abatement considerations and dangers and distraction posed by other traffic." If pilots are hurried through a quick sequence of maneuvers to save aircraft time, the quality of training is diluted, ALPA said.

A second major problem, according to pilots, is a lack of standardization in training. A carrier's supervisory pilots are taught by factory pilots. Line check pilots are taught by the supervisory pilots. In the process, the "personal opinions and ideas of the pilots involved . . . creep into maneuvers and performance demonstrations, resulting in dangerous departures from factory recommended procedures," ALPA said.

Hughes Asks Board To Modify Atlas Order

Washington—Civil Aeronautics Board has extended the May 31 deadline under which Howard Hughes was to sell his Atlas Corp. stock to July 31.

The delay will give the Board time to consider two Hughes proposals to change provisions of an August, 1958, Board order that Hughes place his Atlas Corp. holdings in a voting trust with instructions to sell his Atlas holdings by May 31, 1961. The Board's action was prompted by Hughes' control of Trans World Airlines through Hughes Tool Co. and Atlas' control of Northeast Airlines, a Hughes' relationship CAB found in conflict with the Federal Aviation Act.

Since then, Hughes has relinquished voting control of his TWA stock by placing his Hughes Tool interests in a three-man voting trust until 1970. Hughes argues that since the TWA control situation has changed, the Board should either extend the present voting trust on his Atlas Corp. stock until he regains control of TWA in 1970, at which time the question of violation of the Federal Aviation Act can be reviewed, or extend the termination date of the Atlas voting trust agreement to May 31, 1962 and not require him to sell his Atlas holdings until then. Hughes contends the stock market is depressed so he doesn't want to sell his Atlas stock now.

Hughes is committed to purchase up to $100 million of TWA debentures as of this week. The New York Stock Exchange has been notified by Hughes Tool Co. that no re-offering of the debentures for sale is planned now.

Flying Tiger Receives Its First Canadair CL-44

First of 10 swing-tail Canadair CL-44 freighter transports delivered to Flying Tiger Line touches down at the air freight carrier's base at Lockheed Air Terminal, Burbank, Calif., on its delivery flight from Montreal factory of Canadair, Ltd., a subsidiary of General Dynamics Corp. Flying Tiger plans to begin CL-44 common carrier operations on domestic routes on Oct. 1.

New York Sees No Major V/STOL Transport Phase-in Before 1975

New York—Replacement of fixed-wing transport aircraft to any significant degree by VTOL or STOL types is unlikely to occur in this area by 1975, according to part of the Port of New York Authority's recently released report on airport requirements in the New York-New Jersey metropolitan region.

Thus the report in this respect, as in other basic ways, conflicts with a report prepared for Harding Township, N. J., earlier this year (AW May 1, p. 55).

The Port Authority's new, "definitive" report tacitly confirms an earlier Port Authority study that found an urgent need for a new major airline airport to handle future traffic demands, and which pinpointed a site in Morris County, N. J., as the only feasible location for such an airport.

Harding Township's study was made by United Research, Inc. The Port Authority's study included work by a number of well-known aviation consultants, with James H. Doolittle and Norris B. Harbold acting as general consultants in reviewing the staff and consultant studies composing the report.

Conflict between the studies illustrates the controversy generated in New Jersey by the possibility of construction of a new major airport. Political resistance has been fierce, and the New Jersey legislature has passed a bill which would ban such construction in a variety of locations, including the Morris County site. Harding Township lies in this area.

The United Research study, in finding no need for another airport by 1965, found that fixed-wing aircraft movements would be reduced substantially by commercial VTOL-STOL operations. By 1970, the study found, this type of aircraft would divert from fixed-wing aircraft 75% of traffic on segments under 100 mi.

But the Port Authority report, in a section prepared by R. Dixon Speas Associates, finds "there is no technical basis for acceptance of VTOL or STOL aircraft in significant replacement of fixed-wing aircraft for any scheduled air transport function performed in the New Jersey-New York metropolitan area for the years 1965-1975. . . ."

There is a need, the study finds, for "drastic technological breakthroughs" for VTOLs to achieve a substantial position in commercial air transportation. It is important, according to the study, that operating facilities be made available for VTOL aircraft to support operational development. But it is also important that programs for fixed-wing transport facilities not be delayed "against the day when VTOL aircraft achieve commercial maturity. Such a date cannot be reasonably established . . ."

Airport to airport transfer services by VTOL aircraft (i.e., New York Airways helicopters) will increase in volume during 1960-1975, but airport to city center operation will provide only a small percentage of the total passenger movement requirement. While operating economics of the turbine-powered helicopters now coming into service will permit a decrease in seat-mile costs, the costs per aircraft mile will result in subsidy requirements approximately the same as for present equipment, according to the study. VTOL fleet size in 1965 will be about the same as 1960, although greater speeds and capacities will increase traffic volumes.

The Port Authority report considered 17 possible airport locations, all but two of which were found satisfactory from an engineering standpoint. Controlling criteria were airspace and accessibility; only the Morris County site met both these standards.

The Port Authority report, submitted to the governors and legislators of the States of New York and New Jersey, contains no recommendations. Legislative action is necessary to initiate such an airport project.

FAA Orders Southern To Ground DC-3 Pilot

Washington—Federal Aviation Agency has ordered Southern Airways to ground a Douglas DC-3 captain who, according to agency records, held only a private pilot's license while flying passengers in scheduled service for Southern.

Investigating charges that Southern had hired unqualified pilots to replace those who struck the airline June 5, 1960, FAA discovered that Donald A. Hulihan was not on record as the holder of an airline transport (ATR), instrument or DC-3 type rating.

According to FAA, check pilots who flew with Hulihan on at least three occasions over the last six months found him proficient but failed to note the license discrepancy. Southern, which FAA says was ordered to ground Hulihan on May 26, considers the issue "one between the agency and the pilot." Hulihan presented all the proper licenses when he applied for employment, Southern told AVIATION WEEK. But the airline has complied with the FAA order.

A six-man FAA investigating team—two officials from the Bureau of Flight Standards, two agency attorneys and two agents from the agency's security office—learned of the apparent shortcoming while checking complaints filed by the Air Line Pilots Assn. ALPA has contended that at least 53 of the pilots employed by Southern during the year-old strike are unfit to fly in airline service. Of these, 15 are still under FAA investigation.

While the case is under investigation, an FAA warning not to hire the grounded airman has been sent to U. S. airlines.

Real Estate Decline Pegged on Jet Noise

Los Angeles—Real estate assessments have been reduced as much as 20% in the immediate area of Los Angeles International Airport, in response to property owners' complaints that aircraft noise is damaging the resale value of their homes.

New 1961-62 real estate tax billings for the homeowners affected will reflect an estimated $1.5-million reduction in valuation, and a $120,000 tax loss to the county, spokesmen for the county assessor's office indicate. However, they added, the loss could be recaptured as part of any future increase in the county's real estate tax rate.

Action to lower the assessments came only after "an exhaustive study" by the county and "tremendous pressure" on the part of the property owners, who claimed that the increasing noise from low-flying aircraft, taking off and landing, had accelerated the depreciation rate on their homes. The assessor's office said that talks with real estate agents indicated buyers were willing to move into the airport area, but that the "hysterical mental attitude" of the sellers over airport noise canceled many prospective sales. Because of this conflict over depreciation, the county said, it was thought best to lower the assessments.

Residential property below the ILS approach zone into the airport has had assessments lowered 5 to 10% over a distance of about 4 mi. from the edge of the clear zone with the higher reduction applied to homes below the center of the approach pattern.

Highest reductions have been granted in the exclusive Playa Del Ray part of the city, located beneath the departure clear zone of the airport. Within a four-block area to the south, assessments have been lowered 20% for the street closest to the clear zone, ranging down to 5% for the most distant street.

Breach Widens Between BOAC, BWIA

While talks in London drag over independence for the British West Indies Federation, a breach appears to be widening between the two airlines primarily concerned with the future of aviation there.

British Overseas Airways Corp. has refused to accept the proposed budget of its wholly-owned subsidiary, British West Indies Airways. It has sent Keith Glover, BOAC southern route manager, to BWIA as managing director for the next three-to-six months to review the situation.

In reply came notification to the BWIA board from two of the islands in the proposed federation, Trinidad and Tobago, that they wanted to discuss future ownership of the island carrier. Reaction of both British and U. S. sources was to question whether the two islands, both proponents of a strongly united island confederation, could support an international airline or whether they would want to operate it at the losses BOAC has reported for it.

Disagreement between the two airlines was noted in the Tymms report (AW Dec. 19, p. 52), a report of the Commission of Inquiry on West Indian Aviation appointed by the governor general of the West Indies and headed by Sir Frederick Tymms. The report has had only limited circulation since it was issued, and little progress on its recommendations has been made pending convening of the West Indies Federation Constitutional Conference now going on in London.

Though it did not go into all the details of BOAC-BWIA friction—BWIA, for example, currently is irked at BOAC's failure to placard BOAC Britannias with BWIA markings on flights it operates for BWIA—it did give a clear picture of the opposing interests involved in independence.

Of the major conflicting views on a future West Indian airline, which follow, the Tymms commission supported none completely:

• **BWIA wants long-range** jets for a West Indian airline—preferably Boeing 707-120B turbofan-powered transports—and a pooled share with BOAC of London-New York traffic. It proposes a fleet of three 707s, three Vickers Vanguards and three Viscounts, estimates the long-haul route profits will offset inter-island losses. BWIA now operates Viscounts and DC-3s.

• **BOAC opposes BWIA's** long-haul plans and is concerned about its own interests in the Caribbean. BWIA's transatlantic proposals would be uneconomic and would require at least four and possibly five different types of aircraft, in the opinion of BOAC.

• **Jamaica and some other islands** oppose the idea of a government-controlled and financed airline. Jamaica, which is showing opposition to the whole plan for federation, fears a national airline would not help and perhaps would hinder its development of tourism and commerce by air. Jamaica's position tends to support BOAC's contention that BOAC's investment in development of the New York-Jamaica route gives it claim to more than limited Fifth Freedom traffic after West Indian independence. BOAC, or other large foreign airlines, could better serve Jamaica's own tourism interest, Jamaica feels.

The commission rejected BWIA's Boeing 707 plans as "not financially viable," but it also favored creation of a West Indian airline as the only sure means of ensuring adequate inter-island air transport development. It was critical of the BOAC plan for its lack of a clear perspective of the long-term development of a West Indian airline.

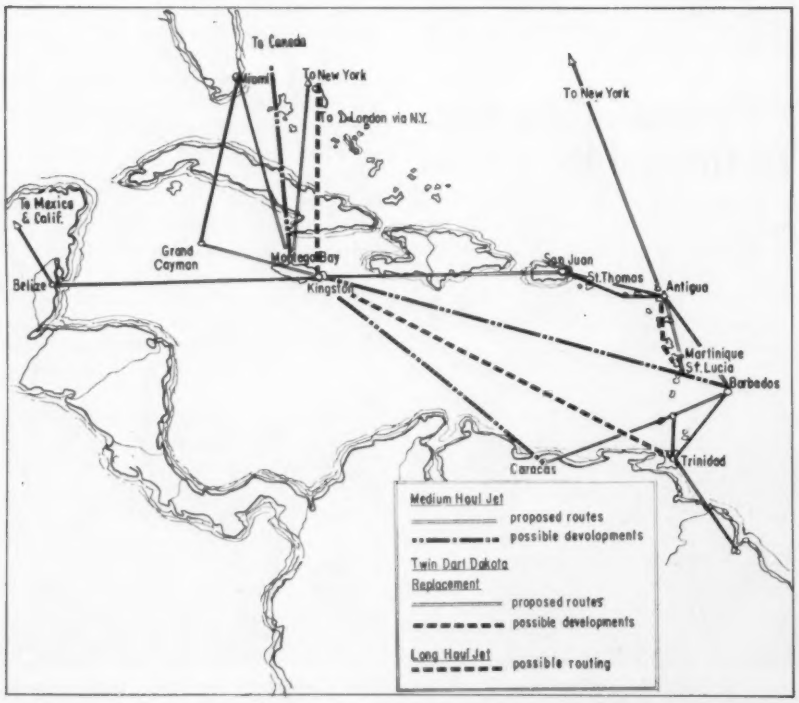
BWIA's (and BOAC's) Vanguard proposals did not find favor with the commission either, though short-term advantages of a Vanguard operation were recognized. Instead the commission proposed:

• **Medium-range jet** purchase—a minimum fleet of four aircraft of the de Havilland 121, Vickers VC.11 or Boeing 727 category for the route pattern envisaged for 1965 (see map, left).

• **Twin-Dart** DC-3 replacement of the Avro 748, Fairchild F-27 or Handley Page Dart Herald category. A minimum of three such aircraft would be needed by 1962 and four by 1964/65.

• **Continued operation** of BWIA's Viscounts, possibly converted to 58-seat versions, on main inter-island routes and to Miami until acquisition of jets. The commission felt BWIA's current Viscount cost level is too high, especially for maintenance, and that BWIA actually could operate these services at a profit instead of at the loss it predicts.

• **Interim arrangements** with BOAC for the New York-Jamaica route and TCA for the New York-Eastern Caribbean route by which these airlines would operate the routes in the name of the West Indian airline and using its traffic rights until the medium jets were delivered. Chartered BOAC Britannias would be used until the West Indian airline could obtain Vanguards on charter from TCA. BOAC—and presumably TCA—should be willing to pay a small percentage-of-revenue fee for use of the West Indian airline's traffic rights though the commission noted even so there was no indication any of these charter arrangments would be profitable to the national airline.



ROUTE PATTERN for 1965 for a West Indian national airline as visualized by the Tymms commission. Proposed medium-range jet routes are primarily those outside the Federation; inter-island routes are proposed for the twin-Dart DC-3 replacement.

BWIA Estimates Proposed Fleet Operating Costs

(000 omitted)

	BOEING 707			VANGUARD			VISCOUNT			TOTAL		
	Revenue	Costs	Profit or Loss	Revenue	Costs	Profit or Loss	Revenue	Costs	Profit or Loss	Revenue	Costs	Profit or Loss
1962/63	16,032	16,357	−324	7,567	8,669	−1,101	2,695	3,856	−1,161	26,294	28,882	−2,587
1963/64	17,011	16,357	6,547	8,324	8,669	−347	2,965	3,856	−891	28,300	28,882	−582
1964/65	17,886	16,357	1,530	9,156	8,669	829	3,261	3,856	−594	30,304	28,882	1,422
1965/66	18,833	17,174	1,659	10,066	9,102	9,635	3,587	4,049	−462	32,486	30,226	2,160
1966/67	19,860	18,033	1,827	11,072	9,558	15,147	3,586	3,938	−351	34,519	31,529	2,990
1967/68	20,696	18,629	2,062	12,179	10,035	2,144	3,587	3,604	−17	36,457	32,268	4,189
1968/69	20,902	19,575	1,327	12,179	10,537	1,642	3,587	3,604	−17	36,669	33,716	2,995

• **London service** should be operated—if the Federation feels the prestige is worth an annual subsidy of more than $1 million—in a less expensive manner than proposed by BWIA.

As possible alternatives for such service the commission proposed:

• **Twice-weekly flights** operated entirely at BOAC's cost in BOAC jet equipment and crews, but with aircraft marked with the Federation airline's colors and crews in West Indian uniforms. Twice-weekly flights are the maximum the commission believes Federation-United Kingdom end-to-end traffic will support.

• **Charter BOAC** 707-420s for the London service.

• **Purchase a single** Boeing 707-420 aircraft which would be integrated with BOAC's fleet for maintenance purposes. This would make possible use of West Indian crews if such an arrangement could not be made for chartered aircraft. By contracting for a reserve BOAC 707 for use during overhaul periods, a twice-weekly service could be maintained with the one West Indian aircraft.

Under favorable circumstances, the commission felt, such services as these might break even, and in any case would not entail a large deficit.

Economic Attraction

Granting BOAC's proposals the attraction of economy, the commission commented that these proposals implied that the West Indian airline ought to be more or less indefinitely confined to the Caribbean.

"We do not disagree, in principle," the commission concluded, "with the advantages which the national airline could derive by chartering aircraft from a larger airline for certain routes until economical operations become possible using its own aircraft. But we do think it is desirable that the national airline should have the prospect before it of a less restricted future than a selling agency."

The commission objected to BWIA's proposed operation of three 707-120Bs on the North Atlantic, not only for economic and competitive reasons, but also because proposed overhaul by a U.S. contractor would not help West Indies employment.

BWIA's projections, the commission said, underestimated 1964-65 expenditure for its proposed operation of three 707-120Bs by $1,088,000 and overestimated revenue by $1,717,000, which would mean a loss of $1,217,000 instead of BWIA's estimated profit of $1,530,000.

Furthermore, the commission said, for this estimate based on the year when the route estimates showed maximum profitability it used optimistic cost figures. If BOAC's more pessimistic cost projections were used, the loss would total $2,747,000. In addition, the commission felt BWIA was overly optimistic about the scale of jet operations which BOAC might reasonably be expected to accept as a parity share of a pool.

BWIA proposed frequencies, depending on season, of four to seven flights a week, Jamaica to New York; five weekly Trinidad to New York and three to seven weekly New York to London.

The commission doubted whether end-to-end traffic between the Federation and London would support this large an operation. BWIA recognizes this—estimating United Kingdom-Federation traffic excluding immigrants for 1962 at 13,500 each way—but is relying heavily on Fifth Freedom New York-London traffic. This would be almost 80% initially and would account for 36% of the total revenue for the Boeing services.

BWIA argued that this high percentage of Fifth Freedom traffic it would receive New York-London would be counterbalanced in the pool by Fifth Freedom revenue BOAC would earn on the New York-Jamaica route. Such a parity is based on BWIA's assumption over the long term of a decline in its Fifth Freedom revenue and an increase in BOAC's, but the commission pointed out the balance would be much in BWIA's favor for the first five years.

In respect to routes, the commission specified those the proposed national airline could be expected to operate upon independence and indicated ones for near-term expansion. The immediate international routes:

• **Trinidad, Barbados,** Antigua, Bermuda, New York, London. Further U.S. points desirable: Washington and Boston. Canadian points: Montreal and Toronto.

• **Kingston, Montego Bay,** New York, London. Intermediate points desirable: Havana and Nassau; Canadian points: Montreal and Toronto.

Future international routes noted:

• **Kingston, Montego Bay,** Belize, Merida, Mexico City, Los Angeles, San Francisco, Vancouver.

• **Kingston, Montego Bay,** New Orleans, Chicago.

The commission alluded generally to a restrictive trend in international bilateral agreements, and advised the Federation not to follow this trend. North and South America are the prime areas for a West Indian airline's future market, the commission feels. Jamaica raised the specific question of whether the U.S. would continue to permit BOAC to operate shuttle services between New York and Jamaica once Jamaica is independent, taking note of this factor as a possible disadvantage in not having a national carrier. It also recognized the possibility that the U.S. might not accept Jamaica's designation of BOAC to serve this route in case there was no Federation carrier. Even so, Jamaica favors seeking other ways of meeting these problems than establishment of a West Indian airline.

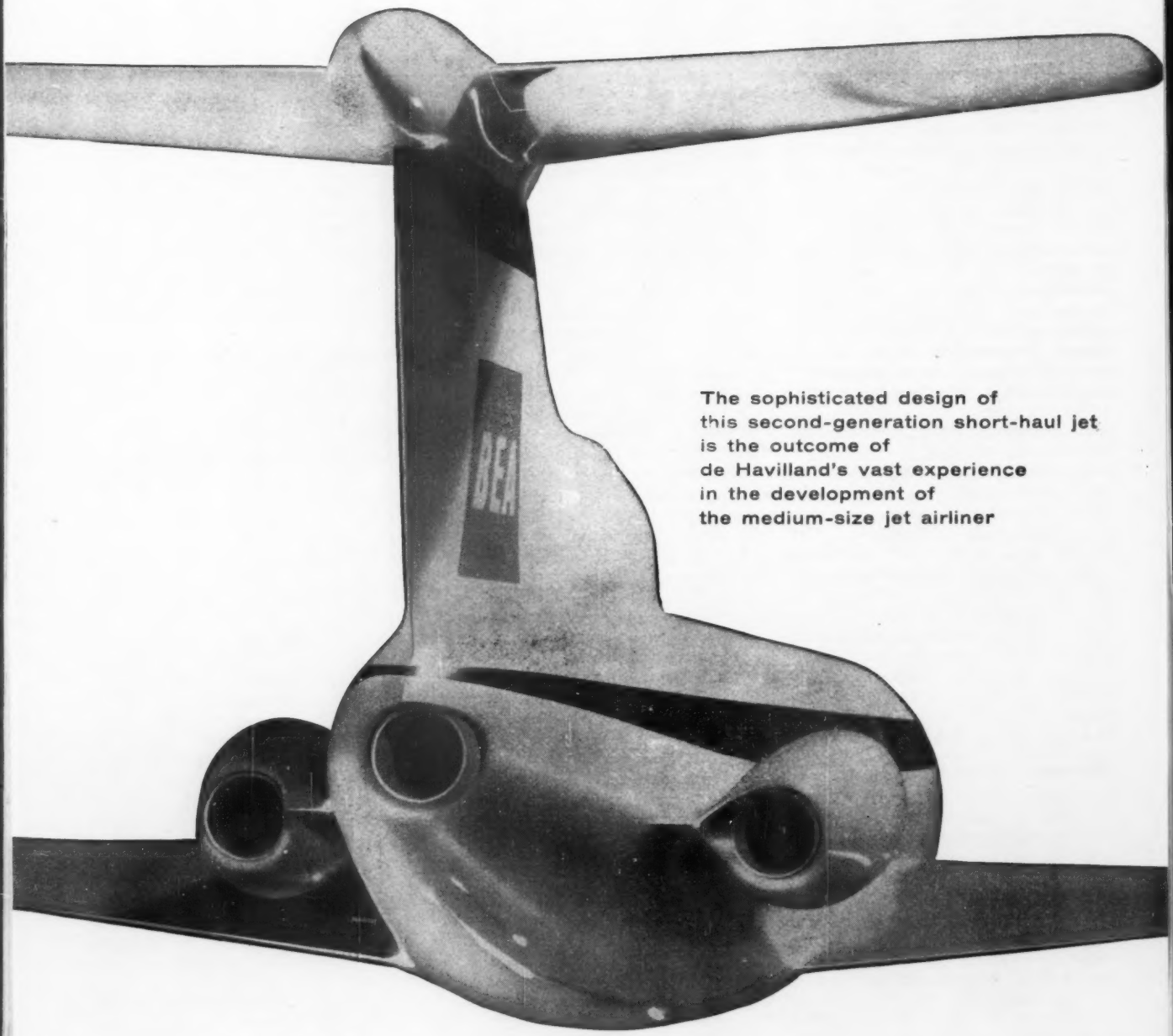
In making its recommendation that the Federation have its own airline, the commission suggested BWIA as the logical nucleus, but proposed both BOAC and TCA as minority shareholders. Government rather than private West Indian ownership was recommended.

Losses incurred by BWIA have been

DE HAVILLAND TRIDENT

(3 Rolls-Royce Spey by-pass jet engines)

leads the way



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substantial, the commission noted—in the six-year period beginning with Fiscal 1955/56 there have been losses each year from a low of $720,000 in 1957/58 to a high of $1,745,000 in 1959/60. BWIA's volume of operations has varied markedly over these years because of changes in services operated on BOAC's behalf, and the commission felt this instability is a significant factor in BWIA's unsatisfactory financial results.

BOAC estimated to the commission that by Mar. 31, 1961, it would have invested $15.5 million in BWIA, and that a fair price for a 51% share of BWIA would be $7.9 million. Recognizing the burden this might lay on the new Federation, BOAC indicated its willingness to negotiate for a lower figure. To this, the commission observed:

"Whereas we have sympathy for BOAC's position in respect to past losses incurred by BWIA, we do not think it would be reasonable for the new shareholders to be asked to burden the new company with a large element of deadwood capital. Indeed we think it would be a great misfortune . . . it might be possible for some compensation for past BOAC losses and development costs to be found from other sources."

Subsidy Required

Subsidy, the commission recognized, would be required for the national airline when the airline is initially formed, at times of introducing new aircraft and for specific operations undertaken to a government requirement.

Opposing payments on an incurred loss basis, the commission recommended instead that subsidy not only be paid on a scale determined in advance of a specified period of operations but that it also be on a descending scale to provide a clear target of cost reduction. This would avoid what the commission termed the three major dangers of subsidy: strong tendency toward self perpetuation, loss of management incentive and low morale due to dependence on external financial aid.

Future operations of Leeward Islands Air Transport, a BWIA subsidiary serving islands with traffic or airports too small for BWIA, as an agent of the national airline met with the commission's favor. This airline, which operates de Havilland Herons and Beech Bonanzas with what the commission called remarkable economy and high standards of maintenance, should have no trouble obtaining future aircraft to suit its small-field, short-range pattern. The commission mentioned the French Super Broussard, the Scottish Twin Pioneer and the Short Skyvan as examples.

United and Western Air Lines Report Officers' Remuneration

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1960 as filed with the Civil Aeronautics Board:

United Air Lines—W. A. Patterson, president, $100,000 salary, 11,648 shares of common stock, 295§ shares of common stock in the name of others; **J. A. Herlihy**, senior vice president-engineering and maintenance, $58,000 salary, 9,105 shares of common stock; **D. F. Magarrell**, senior vice president-transportation services, $58,000 salary, 4,304 shares of common stock; **R. E. Johnson**, senior vice president-sales and public relations, $54,000 salary, 4,440 shares of common stock; **D. R. Petty**, senior vice president-flight operations, $58,000 salary, 2,241 shares of common stock; **C. Barkes**, senior vice president-finance and property, $54,000 salary, 4,495 shares of common stock; **R. F. Ahrns**, senior vice president-personnel, $43,000 salary, 3,589 shares of common stock; **H. E. Nourse**, senior vice president-economic controls, $35,000 salary, 4,369 shares of common stock; **C. F. McErlean**, vice president-law, $37,000 salary, 555 shares of common stock; **S. P. Martin**, corporate secretary and assistant to the president, $24,000 salary, 930 shares of common stock, $1,000 debt securities; **R. E. Bruno**, comptroller and assistant secretary, $28,300 salary, 679 shares of common stock, 39 shares of common stock in the name of others; **A. M. DeVoursney**, vice president and treasurer, $30,000 salary, 424 shares of common stock; **G. E. Keck**, vice president-maintenance, $30,000 salary, 347 shares of common stock; **O. T. Larson**, vice president-ground services, $33,000 salary, 650 shares of common stock; **O. C. Enge**, vice president-passenger service, $29,000 salary, 875 shares of common stock; **I. E. Sommermeyer**, vice president-flying, $38,000 salary, 312 shares of common stock; **J. M. Hodgson**, vice president-communications, $35,500 salary, 1,120 shares of common stock, 375 shares of common stock in the name of others; **B. B. Gragge**, vice president-marketing, $31,400 salary, 900 shares of common stock, 353 shares of common stock in the name of others; **R. M. Ruddick**, vice president and assistant to the president, $21,333 salary, 56 shares of common stock; **J. E. Moore**, vice president-traffic, $25,000 salary, 579 shares of common stock; **W. C. Mentzer**, vice president-engineering, $42,000 salary, 1,149 shares of common stock; **H. J. Merchant**, vice president and sales manager, $28,500 salary, 27 shares of common stock, 337 shares of common stock in the name of others; **D. V. O'Leary**, vice president-purchasing and stores, $28,300 salary, 798 shares of common stock; **D. C. Meenan**, vice president-facilities and property, $24,000 salary, 636 shares of common stock; **C. M. Mason**, vice president employe relations, $28,000 salary, 664 shares of common stock; **L. F. Hampel**, vice president-business research, $22,400 salary, 154 shares of common stock; **W. E. Alberts**, vice president and assistant to the president, $25,500 salary, 152 shares of common stock; **M. C. Ansorge**, director, $3,500 salary, 1,100 shares of common stock, $3,000 debt security; **P. A. Bissenger**, director, $3,600 salary, 2,133 shares of common stock, $5,000 debt securities; **H. T. Brown**, director, $3,800 salary, 476 shares of common stock; **C. Cowles**, director, $3,700 salary, 10,283 shares of common stock; **J. W. Dart**, director, $3,000 salary, 14,705 shares of common stock; **T. F. Gleed**, director, $3,700 salary, 2,757 shares of common stock, $75,000 debt securities; **P. G. Hoffman**, director, $3,100 salary, 1,299 shares of common stock, $7,600 debt securities; **E. A. Johnston**, director, $3,400 salary, 4,911 shares of common stock; **J. J. Mitchell**, director, $3,300 salary, 5,374 shares of common stock; **A. Nielsen**, director, $3,700 salary, 1,049 shares of common stock, $10,000 debt securities; **V. Stouffer**, director, $3,300 salary, 2,123 shares of common stock, $10,000 debt securities.

Following firms were paid for services rendered during 1960: **Authur Andersen & Co.**, audit, $102,435; **Ragnar Benson, Inc.**, architecture and engineering, $57,799; **Booz-Allen & Hamilton**, personnel management services, $76,423; **John C. Bowers Co.**, property management, $18,925; **Brobeck, Phelegor & Harrison**, legal, $20,585; **B. M. Doolin**, airport consulting service, $9,600; **Griswold, Heckel & Keiser**, architects, $23,988; **Hardin, Hess & Eder**, legal, $16,530; **Hopf & Adler**, architecture, $10,186; **John L. Hunter**, architecture and engineering, $5,175; **Leigh Fisher Associates**, airport consulting service, $10,770; **Raymond Loewy Associates**, designing, $8,253; **Loubet & Glynn**, architecture and engineering, $7,390; **Mayer, Friedlick, Spiess, Tierney, Brown & Platt**, legal, $361,063; **James Francis Reilly**, legal, $33,093; **Seelye, Stevenson, Value & Knecht**, architecture and engineering, $25,720; **Skidmore, Owings & Merrill**, architecture, $222,340; **J. R. Steelman**, economic consultant, $13,500; **Trippel, Yoakum, Stearns & Ballantyne**, legal, $6,187; **Young, Richardson & Carleton**, architecture, $7,912; **Stanford Research Institute**, research and consulting service, $41,004.

(United officers and directors did not receive bonus or indirect compensation during 1960. United will make expense information available later).

Western Air Lines, Inc.—T. C. Drinkwater, president and director, $76,633 salary, 7,000 shares of common stock, $16,003 expenses; **S. R. Shatto**, vice president-operations and director, $48,933 salary, 3,991 shares of common stock, $2,690 expenses; **M. W. Landis**, vice president-service, $38,000 salary, 1,680 shares of common stock, $1,197 expenses; **A. F. Kelly**, vice president-sales, $38,000 salary, 3,436 shares of common stock, $6,252 expenses; **J. J. Taylor**, vice president and treasurer, $38,000, salary, 2,900 shares of common stock, $1,500 expenses; **D. P. Renda**, vice president-legal and secretary, $38,000 salary, 1,069 shares of common stock, $6,029 expenses; **S. Gewirtz**, vice president-administration $34,500 salary, no stock, $16,337 expenses; **G. G. Brooder**, vice president, $29,667 salary, 1,000 shares of common stock, $10,244 expenses; **C. J. Cox**, controller and assistant treasurer, $29,667 salary, 1,684 shares of common stock, $1,553 expenses; **W. C. Jennings**, assistant secretary, $16,800 salary, 105 shares of common stock, $137 expenses; **J. W. Simpson**, assistant secretary, $16,800 salary, 100 shares of common stock, $5,403 expenses; **H. W. Darling**, director, $500 salary, 3,000 shares of common stock, no expenses; **R. E. Driscoll, Sr.**, director, $700 salary, 1,500 shares of common stock, no expenses; **H. C. Haight**, director, $900 salary, no stock, 256 shares of common stock in the name of others, $18 expenses; **G. Lowry**, director, $500 salary, 1,356 shares of common stock, $22 expenses; **Dr. D. H. McLaughlin**, director, $500 salary, 146 shares of common stock, no expenses; **E. W. Pauley**, director, $300 salary, 3,150 shares of common stock, no expenses; **L. W. Pogue**, director, $300 salary, 1,545 shares of common stock, $106 expenses; **D. Swim**, director, $600 salary, 28,616 shares of common stock, $149 expenses; **H. J. Volk**, director, $700 salary, 700 shares of common stock; **J. M. Wallace**, director, $600 salary, 649 shares of common stock, no expenses; **A. Warden**, director, $600 salary, 276 shares of common stock, no expenses; **S. F. Woodbury**, director, $5,000 salary, 189 shares of common stock, $70 expenses.

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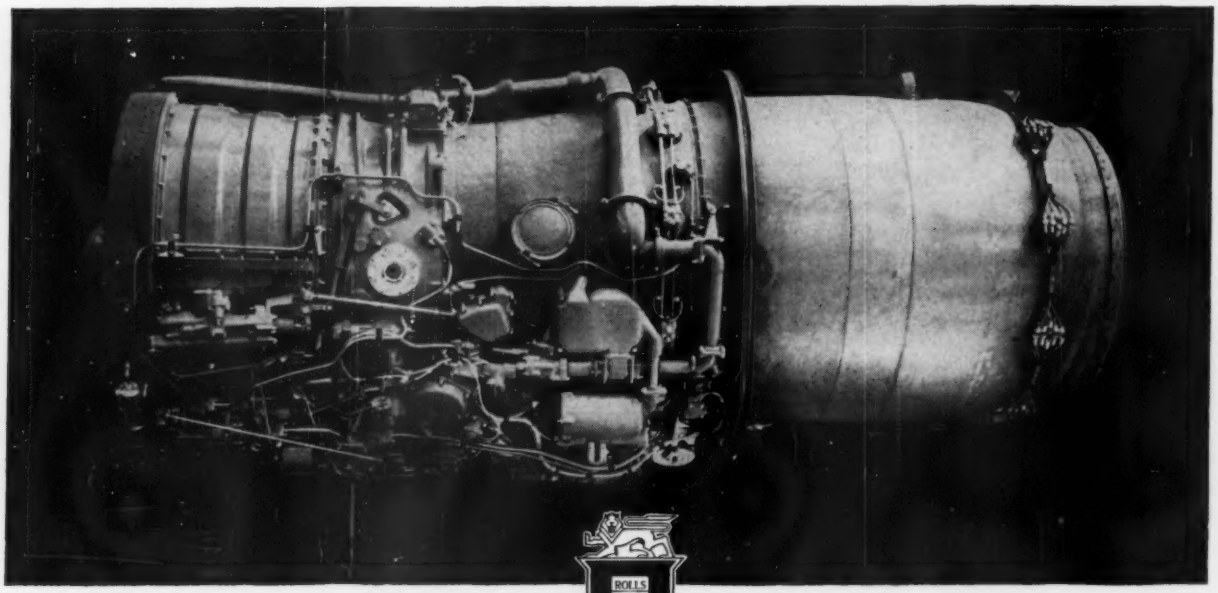

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Airlines Brace for Tough Engineer Stand

By Robert H. Cook

Washington—Airlines are bracing to face tougher collective bargaining demands from the Flight Engineers International Assn. in the wake of the union's complete rejection of the pilot-engineer merger recommended by a special presidential commission to settle the long-standing cockpit jurisdiction battle.

Industry concern that the engineers' dissatisfaction with the findings might trigger a second, large-scale strike by the union has subsided, however, in the wake of an FEIA statement that the union will press for individual airline adoption of reduced monthly flight times and "on duty" times as the most practical means of resolving the cockpit feud.

The union emphasized that it will continue to discuss the problems with the presidential commission and its chairman, Nathan Feinsinger, while negotiating with the carriers for new contracts under Railway Labor Act procedures.

Meanwhile, the commission met last week with the airlines and will meet this week with FEIA in an intensive effort to make some progress toward mutual acceptance of its recommendations by the end of the month. Failure of the parties to commence bargaining under the commission's recommendations by June 24 may require further recommendations "as may then seem desirable," Feinsinger said.

Chances Slim

There is little chance of any cooperation by June 24 on the key recommendation of merger between the two unions, abandonment of the third pilot position and pilot training for flight engineers. Both the Air Line Pilots Assn., which stands to lose the third pilot seat, and the airlines, with mixed crew configurations and qualifications and facing possible heavy training costs to qualify engineers as pilots, have reserved comment on the report.

FEIA contends that any analysis of the report is difficult because of the "ambiguity" of its wording and intent, but that it appears the recommendations literally put the crew complement argument "right back where it was." Noting that the report makes no recognition of FEIA recommendations that monthly flight time limitations for all crew members be reduced from the present 85 to 70 hr. as a means of offsetting job reduction effects of jet operations, the union said it will continue to urge this position, both in further talks with Feinsinger and in contract negotiations on a carrier-by-carrier basis.

In a presidential Emergency Board report on a 47-day strike of International Assn. of Machinists flight engineers against Northwest Airlines last January, an IAM demand for the same flight time reduction was rejected by the board on grounds that the union's demands were premised on "current and as yet uncompleted" research on fatigue problems of engineers in turbojet operations.

There is now strong airline industry opinion that the Feinsinger report's complete lack of comment on FEIA's suggestion to reduce monthly flight limitations may indicate that a series of current negotiations with the carriers, involving both pilots and engineers, may resolve this question without the need for any recommendations by the presidential commission.

ALPA has never made any official demands for the 70-hr. month, although the matter has been discussed with airline managements by several councils and the union has been urging the airlines to lower the total "on duty" times now in effect. Under this formula, pilots are credited with a set scale of flight pay credit for each hour on duty, so that any reduction in the over-all time would automatically produce a lower monthly flight time limitation.

ALPA contracts now provide for an 85-hr. monthly flight limitation, but various "duty rigs" often bring this figure much lower. The pilots' union is now in mediation over contract negotiations at Trans World Airlines, a presidential fact-finding board is in session at Pan American World Airways and negotiations have been temporarily recessed on American and Delta Air Lines.

FEIA, which wants both the monthly flight time limitations and duty times reduced, is also under a presidential fact-finding board at Pan American, has resumed talks with National under the National Mediation Board and is in mediation at Trans World and Eastern Air Lines. Negotiations can be reopened with American over wages, the union said. Western was in the process of mediation when the engineers struck seven carriers in February, and further talks with United Air Lines have been recessed pending court action reviewing the NMB decision on the airlines.

Because of the Pan American and United situations, the engineers are optimistic that they may yet win concessions from the airlines and avoid what they consider a threat to their union's future if the Feinsinger group's recommendations are carried out.

The union lost a petition to stay a representative election at United, but the U.S. Court of Appeals recommended a full review of the NMB decision and has scheduled a hearing June 16. Should the court rule against the NMB decision, FEIA feels it would ward off the possibility of representative elections on other carriers.

Meanwhile, ALPA has won the election to represent all cockpit crew members at United by a vote of 1,682 of the 1,761 valid votes cast, with 58 favoring FEIA. The flight engineers point out, however, that more than 340 FEIA members refused to vote in the election in protest against the NMB decision.

If the Feinsinger commission is unable to bring labor peace in the cockpit, Federal Aviation Agency Administrator Najeeb Halaby may act on his warnings that FAA could settle the dispute under "existing legislation." Halaby has not spelled out exactly what he could do, but it is generally conceded that he would change crew complement regulations defining the exact qualifications, training and duties for the flight engineer, revising them to reflect the changing operational problems of turbojet operations.

Potential Opposition

However, even this possible solution faces possible airline opposition which could block or delay its implementation. Changes made in copilot training and qualification regulations were not as extensive as requested by ALPA because of carrier objections to the heavy cost of more extensive and frequent training programs.

Terming the airline industry's crew configurations a "patchwork," Feinsinger said the entire controversy has been "marked through by irresponsibility and unreasonableness." FEIA has "frustrated" the commission's efforts by insisting that the government, ALPA and the carriers must "first capitulate" to FEIA's position on the United representation issue, he said.

ALPA has showed little concern that its exercise of a statutory right in requesting the NMB election led to a strike, he said, and also has declined to consider the fears of flight engineers that such action may jeopardize their job security. The carriers, he emphasized, "act like helpless victims caught in the cross-fire between two hostile forces." The airlines' loss of bargaining strength stems partially from their "failure to accept managerial responsibilities" and their tendencies to "temporize and seek expedient solutions," he said.

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AIRLINE OBSERVER

► **Fairchild Stratos Corp., which is preparing to offer a stretched version of the F-27 with more fuel capacity and longer range, designated the F-27F, still is in the running for a Navy order to replace DC-3s used at U. S. embassies and missions overseas (AW Apr. 17, p. 23). Navy planned to request funds to buy about 35 Grumman Gulfstreams, but Fairchild has gained a rehearing by citing $200,000 lower price of the larger F-27 and possible advantages of the airplane in taking the General Electric T64 engine and providing a cargo door and cargo carrying capacity.**

► Senate Aviation Subcommittee has scheduled hearings on a bill to define supplemental airline operational authority for June 26, 29 and 30. The bill would clarify the Civil Aeronautics Board's powers to certificate supplemental operations, lower some of the certificate qualifications and grant permanent operating rights to many of the airlines. The supplementals now operate under 20-month stop-gap legislation approved by Congress last July.

► **Integration of pilot union seniority lists is one of the last unresolved issues in the recent merger of United and Capital Airlines. Several months of discussion between the Air Line Pilots Assn. councils of the two carriers have failed to settle the pilot seniority question and the issue may be decided by ALPA arbitration next month. Air Line Dispatchers Assn. and the International Assn. of Machinists have successfully completed seniority integrations, but IAM is concerned over indications that United will lay off several hundred employes by the end of this year.**

► Airline routes between the U. S. and Europe are an issue before the North Atlantic Treaty Organization nations. After the foreign ministers conference in Oslo, Norway, last month, foreign ministers from both The Netherlands and Denmark protested against the U. S. stand on traffic rights and route structures during the conference.

► **Czechoslovakia has lodged an official protest with the West German government over the "extremely slow progress of the investigation" into the cause of the Mar. 28 crash of a Czechoslovakian Airlines' Il-18 near Nuremberg. All 52 persons aboard the Russian-built turboprop transport, which was carrying Communist-bloc technicians to West Africa, were killed in the accident.**

► Allegheny Airlines may acquire U. S. sales rights for the Canadair 540 as a means of diversifying its business and reducing subsidy needs. Currently operating five of the twin-turboprop aircraft, the airline has discussed increasing its 540 fleet by seven aircraft and taking an option for an additional 10. The sales proposal was made during initial talks and negotiations are still under way, according to Canadair.

► **Japan Air Lines plans to start a helicopter service between downtown Tokyo and Tokyo International Airport by August next year. Under a proposal made to the Japanese government, the carrier would establish a subsidiary company for the service with an authorized capital of $1.1 million. Sikorsky S-61 or Vertol 107 equipment is to be used initially.**

► Madrid's new airport terminal, scheduled for operational use by early 1963, is already under fire from airline personnel in Spain. Chief complaint is that only a small portion of the huge building has been designated for passenger services, and that handling of passengers will be slow, cumbersome and inconvenient.

► **Eastern Air Lines' turbojet transport delivery schedule for this year is well ahead of schedule, with the last four Douglas DC-8s expected July 31, Aug. 20, Sept. 11 and Oct. 23. First two of Eastern's order of 15 Boeing 720s are expected on Aug. 18 and 31, with 12 to be in the fleet by the end of the year.**

► Vickers Armstrongs, Ltd., is installing liquid oxygen on its VC.10 turbojet transport as a weight-saving measure. One 30-liter capacity bottle of liquid oxygen weighs 200 lb. less than the conventional gaseous oxygen supply and has an operating pressure of only 300 psi. Three VC.10s are now on the Weybridge line, with the third aircraft scheduled for static and stress tests by the manufacturer.

SHORTLINES

► **Bonanza Air Lines** has received its ninth turboprop Fairchild F-27A.

► **Braniff International Airways** reports a net loss of $406,746 for the first quarter of 1961, compared with a net loss of $486,968 for the same period last year. System revenues rose 8.6% this year and costs rose 6.54%.

► **Civil Aeronautics Board** has disclaimed jurisdiction over an agreement between Boeing Airplane Co. and Eastern Air Lines in which Eastern will trade in 40 DC-7B aircraft as partial payment for 40 Boeing 727 intermediate-range turbofan transports.

► **Federal Aviation Agency** has issued a provisional certificate for the Sikorsky S-61L twin-turbine helicopter to enable Sikorsky to train pilots and conduct market surveys and demonstration flights. Target date for full FAA certification is Aug. 1.

► **International Air Transport Assn.** North Atlantic cargo rate agreement has been extended to Sept. 1, 1961, with Civil Aeronautics Board approval.

► **International Air Transport Assn.** reports 1960 air passenger traffic within Europe increased 20%, cargo rose 18% and mail increased 7% over 1959. Of over 10 million passengers carried in intra-European traffic during 1960, 93% traveled tourist class.

► **Netherlands** Department of Civil Aviation has approved increased maximum takeoff weight limits for Fokker F-27s of 39,000 lb. when powered by Rolls-Royce Dart 6 turboprop engines and 42,000 lb. when powered by Dart 7 turboprops.

► **Northwest Airlines** will begin moving its general offices from St. Paul, Minn., to Minneapolis-St. Paul International Airport on June 15.

► **Pacific Airmotive Corp.,** has a $1-million contract to overhaul Western Air Lines' Boeing 720B Pratt & Whitney JT3D turbofan engines.

► **Sabena** reports the 300,000th passenger was carried on its helicopter service in May. Sabena helicopters have been operating between Belgium, France, The Netherlands and West Germany since 1953.

► **Western Air Lines** has placed Boeing 720B turbofan transports in scheduled service between Los Angeles, San Francisco and Seattle/Tacoma.

Microdot Inc. Adds Projects and Products

Owen Lab. Products Added. Strain gage power supplies and control equipment produced by Owen Laboratories have been acquired by Microdot. The acquisition furthers Microdot's expansion in the instrumentation field, and provides strain gage conditioning equipment compatible with other existing Microdot products.

Power Oscillator Offered. As a result of its acquisition of Spectralab Instrument Company, Microdot is offering a line of power oscillators for laboratory use in the evaluation of power measuring devices, driving amplifiers, and other applications where higher power ratings are required.

Model 410 oscillator, shown above, offers a frequency range of 500 to 1050 mcs direct reading. Power range is 50 mv to 50 w. The unit measures 8″ x 11½″ x 19″ and weighs 45 pounds.

Martin Awards Contracts. Assignments for the development of precision temperature measuring systems for the advanced version of the Titan II missile have been awarded to Microdot by the Martin Company, Denver, Colorado. Solid state designs of sophisticated telemetry equipment for extreme environments will be utilized. The systems will be designed, tested, and produced in Microdot's San Diego Division.

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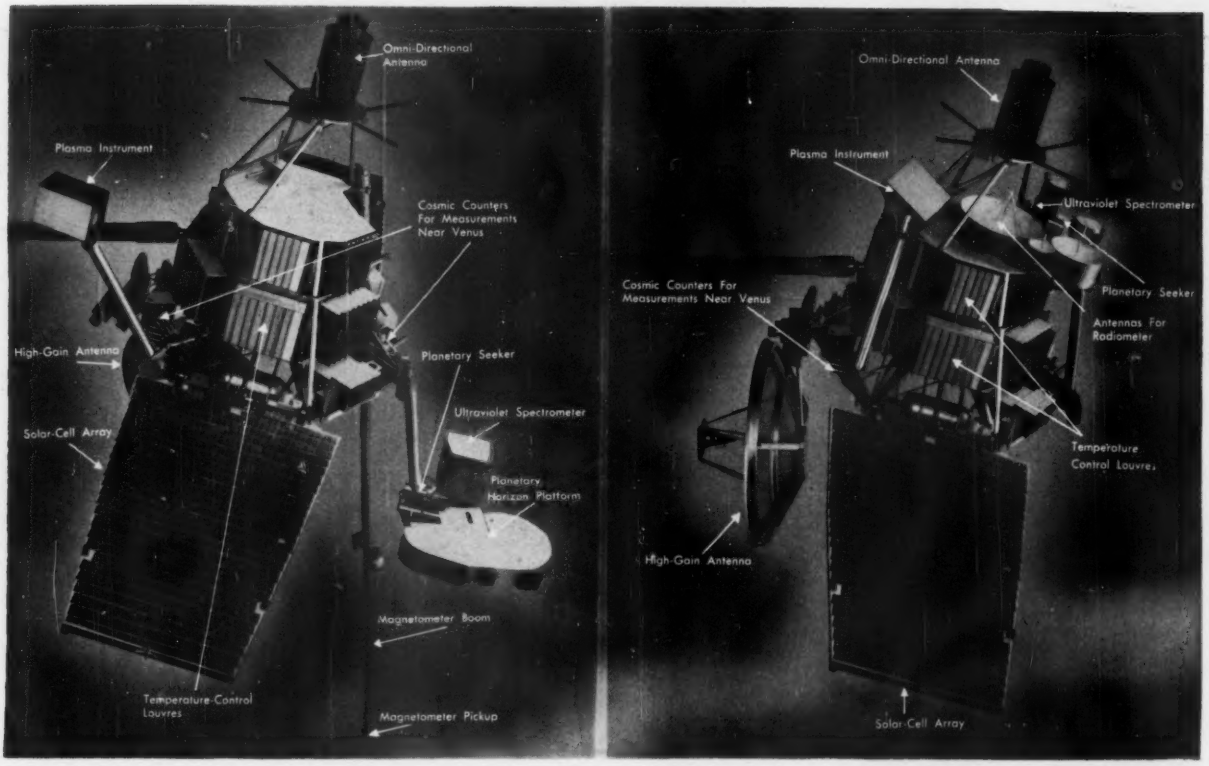


PHOTOS of Mariner A Venus flyby prototype models show solar panels, each with 20-sq.-ft. area, extended in common plane. Magnetometer and plasma booms will be extended simultaneously after spacecraft's midcourse maneuver. Horizon scanner and ultraviolet spectrometer will begin to function after planet "encounter"—when spacecraft is about 95,000 mi. from the cloud-covered, slow-spinning planet. Trajectory period to the end of the flyby may vary from about 91 days to about 158 days.

Mariner to Scan Venus' Surface on Flyby

By Irving Stone

Los Angeles—Mariner A spacecraft, projected to weigh about 1,000 lb. and programed to miss Venus by about 16,700 mi. as it goes into a heliocentric orbit, will be launched late next year from Cape Canaveral by an Atlas-Centaur boost vehicle.

NASA's Jet Propulsion Laboratory has responsibility for the program—an in-house effort supported by a broad base of industry and university contractors. Specific number of vehicles scheduled for the Venus and follow-on Mariner probe experiments has not yet been firmed, but as many as five vehicles may be programed initially.

Launch "window"—feasible calendar period for the Mariner A firing—will be within the span of about 67 days, according to JPL specifications.

Trajectory period to the end of the Venus flyby may vary from a short time of approximately 91 days to a long time of about 158 days, to traverse the distance of more than 26 million mi.

One of the key considerations in the experiment will be the payload differential. The vehicle will be capable of boosting a specific weight to a specific velocity, hence the tradeoff will become one of velocity for weight. For the optimum launch date, the heaviest payload can be carried for minimum velocity to get to Venus (see chart).

Advantage in the shorter flight time is that operational life of the equipment need not be extended. To obtain this shorter flight time, however, it will be necessary to launch at the end of the period for permissible launch span, and if technical problems are encountered, it will be necessary to wait another 19 months for the next appropriate launch date.

Expected Data

About 8 to 10 hr. of data on Venus' specific environmental factors are expected to be obtained. Experiments carried will be state-of-the-art developments—"there's plenty to do within the present state-of-the-art," declares R. J. Parks, JPL planetary program director. Complete instrumentation has not yet been firmed, but basic experiments probably will include:

- **Radiometer,** to make a latitude scan of Venus' surface temperatures.
- **Ultraviolet spectrometer,** for measurement of spectral characteristics not only in the sunlight scattered from the planet's disk, but also in the night air glow and planetary aurora.
- **Magnetometer,** to measure the Venusian magnetic field, as well as the interplanetary field between earth and Venus.
- **Plasma detector,** to determine the quantity of interplanetary plasma.
- **Radiation counters,** to ascertain the existence of "Van Allen belts" around Venus and to make measurements en route to the planet.
- **Micrometeorite counters,** for measurement of impact of these bodies on the spacecraft in interplanetary space.

Polarization tubes might be included to measure the degree of polarization of light reflected from the atmosphere of Venus as a function of phase and viewing angles.

Active radar for mapping the Venusian surface through the opaque cloud cover will not be included in the Mariner A vehicle, but its use is being ex-

amined for follow-on Mariner experiments. Similarly, optical absorption properties of the atmosphere of Venus will not be investigated with the initial Venus probe.

Mariner A's trajectory will include these key events—after injection of the spacecraft, solar panels will be unfolded, the planetary horizontal platform will be unlatched, and hermetic seal for the particle spectrometer removed. These events will occur in rapid succession and, according to JPL specifications, are programed for 38 min. after launch.

The solar panels will be deployed by firing two groups of four squibs in sequence, four squibs will be required for the platform unlatching, and four for the particle spectrometer operation.

Each of the two solar panels will have an area of approximately 20 sq. ft. upon deployment, the panels will be extended into a common plane. As a function of the trajectory, the solar panel voltage will tend to decrease as the flight progresses, but power available from the panels will tend to increase during the same period. Minimum power available from both panels will be about 300 watts at the beginning of the flight, and maximum power available toward the end of the flight might be as much as 600 watts. However, energy source (battery) requirements will be based on a minimal increase in panel power during the flight.

Power will be supplied by the solar panels or the batteries, not by both at the same time.

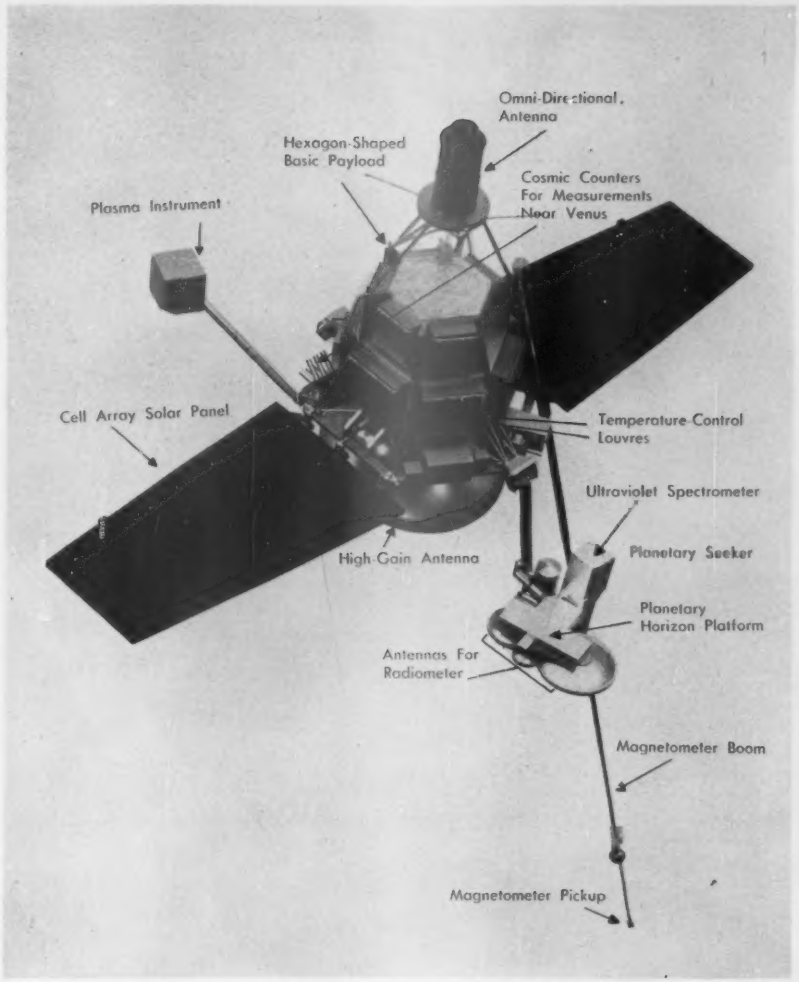
Midcourse Maneuver

Prior to any midcourse maneuver the attitude of the spacecraft will be oriented for the sun to be straight ahead along the roll axis, with the solar panels getting the full blast of the sun, and the directional antenna pointed back to earth. This is called the cruise mode and will be accomplished with sun and earth sensors which will control cold nitrogen jets to position the spacecraft. Tracking from JPL's Goldstone, Calif., station will determine any error in the trajectory course, the required correction will be transmitted to provide the proper amount of roll and pitch, and the hydrazene monopropellant rocket motor will be fired, using nitrogen tetroxide for starting, to provide the velocity increment.

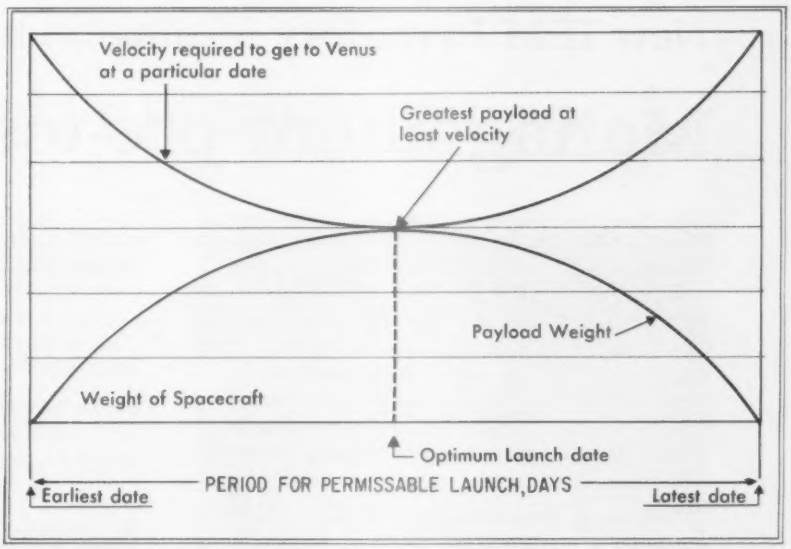
Magnetometer boom and solar plasma boom will be extended simultaneously by firing two squibs for each operation at 84 hr. after launch, according to JPL specifications.

Extension of the magnetometer and solar plasma booms is delayed until after the midcourse maneuver in order to maintain the center of gravity of the spacecraft.

A second midcourse maneuver is programed for the trajectory, but it is



MARINER A Venus flyby prototype model reveals basic construction of the spacecraft projected to pass within 16,700 mi. of the planet after 26-million-mi. trajectory from Cape Canaveral. At flyby, most of the data will be stored in a memory unit and transmitted to earth during succeeding two days as spacecraft goes on for orbit around the sun.


Velocity required to get to Venus at a particular date
Greatest payload at least velocity
Payload Weight
Weight of Spacecraft
Optimum Launch date
PERIOD FOR PERMISSABLE LAUNCH, DAYS
Earliest date
Latest date

MARINER A Venus probe relationships between payload weight, velocity required, and firing window in terms of calendar days.

New IBM Inventory Management Simulator

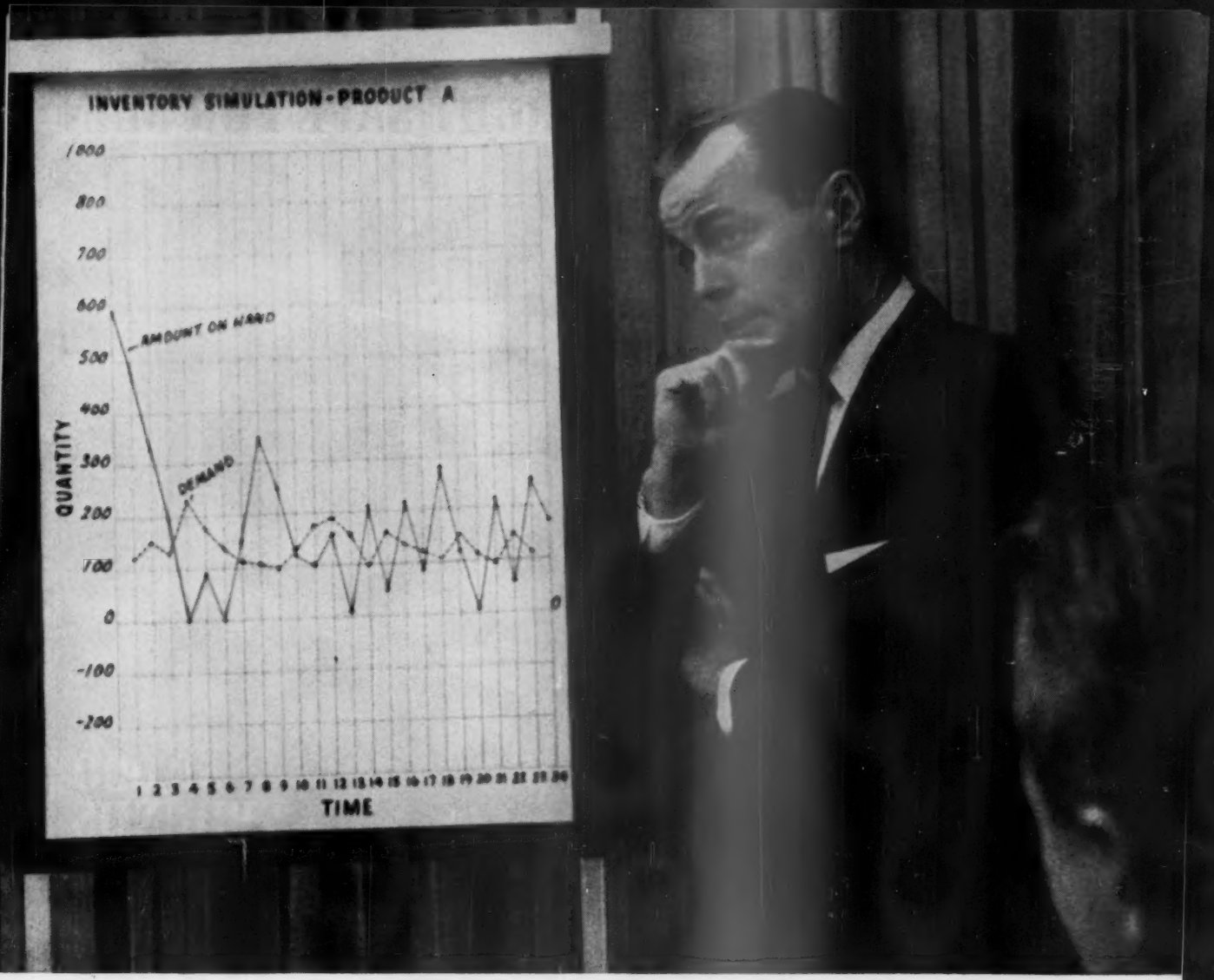
Management pre-tests inventory

How often have you wanted to peer into the future... see the probable results of your inventory policy? **Now you can.** An IBM data processing technique—Inventory Management Simulation—establishes the computer as an invaluable management tool for problem solving and decision making.

This technique lets you test and evaluate alternate plans electronically without disrupting present operations. In effect, it lets you turn *hindsight* into *foresight.*

Simulation is performed by creating within the computer a mathematical model of an inventory control system. Then the model is subjected to various demand situations. In every case, the computer reports what would have happened had this particular system been used to handle each situation. Of course, both the model and the demand factors can be endlessly varied.

Here's the important thing: Through simulation, the trial-and-error method of determining a course of action is performed within the computer—not during the course of your firm's business. This gives you a fast way to test plans under a wide range of conditions before actually putting them



LOOKING AHEAD. Management has run a computer simulation of a proposed inventory plan. Company executives (above) now examine charted results showing how the plan might work, what problems might arise, where improvement might be sought. Print-out sheet (below) from an IBM computer contains facts needed to judge long-range results of a given inventory control plan. Inventory Management Simulation takes much of the guesswork out of planning.

decisions with electronic speed

to use. Unprofitable or inadequate courses of action show up in advance. You avoid them. And you select with confidence the system best suited to your firm's objectives.

Getting started. If you are an IBM customer, you can take advantage of the Inventory Management Simulation Program at once. IBM helps you collect the facts you need... and helps you set up a computer program to analyze them.

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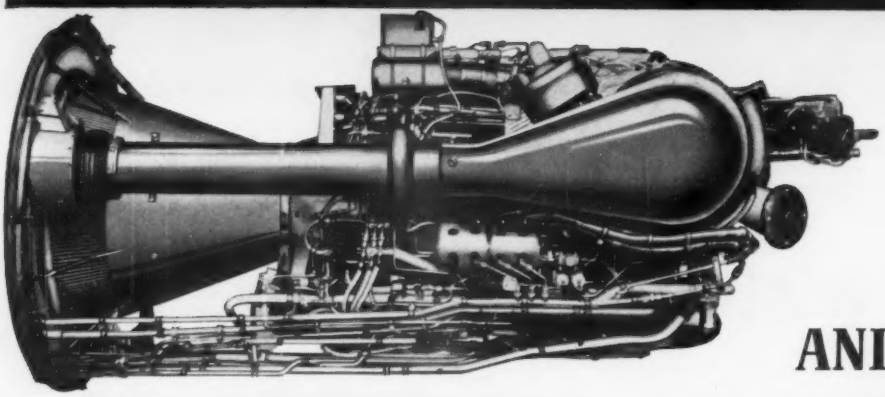

XLR99 POWER-TAMED FOR MANNED SAFETY AND CONTROL

The X-15, developed by North American Aviation and now in the capable hands of the Air Force and NASA, carries man higher and faster than ever before—to the outer fringes of the atmosphere. Its XLR99 engine has the power of an ICBM sustainer and the human controls and shut-down capabilities needed for repeated, pilot-safe flights. Basic design of the XLR99 makes it suitable for other aerospace applications of the future.

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PUSHING BACK FRONTIERS OF SPEED AND SPACE. ROCKET ENGINES FROM REACTION MOTORS DIVISION OF THIOKOL, PIONEER OF ROCKET POWER FOR MANNED FLIGHT, POWERED THESE AIRCRAFT ON THEIR RECORD-BREAKING MISSIONS

OCTOBER 1947. Bell X-1 powered by 6000 pound thrust engine... first to break the sonic barrier in level flight.

SEPTEMBER 1952. Republic XF-91 with 6000 pound thrust engine became first combat type plane to exceed speed of sound in level flight.

SEPTEMBER 1953. Bell X-1A topped 1650 mph. in level flight and flew to an altitude of over 90,000 feet with RMD's XLR41 engine.

NOVEMBER 1953. Douglas SKYROCKET hit 1327 mph., reached 83,000 feet with RMD's 6000 lb. thrust engine.

AUGUST 1959. X-15 smashed all records with twin XLR11's. Now expected to achieve 4000 mph. and altitudes over 50 miles with XLR99.

Venus Data

Mariner A Venus probe promises to return considerable data on the physical nature of the planet and its environment and the characteristics of interplanetary space between it and the earth.

Information about the planet is relatively meager. Its atmosphere is opaque, contains at least 500 times the quantity of carbon dioxide present in the earth's atmosphere. A small amount of water vapor is present above the reflecting layer. The total water content is unknown. Surface temperatures and atmospheric constituents also are scientific questions.

The recent Venus radar bounce experiment conducted by Jet Propulsion Laboratory will add to the fund of knowledge Mariner A is expected to produce in the Venus flyby. The bounce experiment has indicated that Venus spins at a very slow rate, perhaps as little as one revolution for each 225-day orbit around the sun. A new accuracy established for the Astronomical Unit—mean distance between the earth and the sun—by the bounce experiment is supposed to bring this value within an accuracy tolerance of plus or minus 100 mi. when data from the experiment are refined.

unlikely that this will be used. Probable successive use for the hydrazene monopropellant rocket motor will be as a propulsion experiment at the end of the flight—after all data have been obtained—to demonstrate capability for an indefinite number of restarts after many days of flight.

From the start of planet "encounter" —when the spacecraft is approximately 95,000 mi. from Venus—the cover of the horizon scanner will be removed by the blowing of two squibs. No difficulties are expected in the acquisition of the planet with this scanner, an infrared device, at this distance.

Cover Removed

Ultraviolet spectrometer cover will be removed by blowing two squibs four hours after start of planet encounter, according to JPL specifications, but it is likely that this experiment will be begun immediately after planet encounter because the sooner the instruments scans, the more data can be acquired.

During the 8-to-10-hr. flyby the trajectory will be 16,700 mi. from the planet since this is as near as the spacecraft can be aimed without approaching too close to chance the loss of results with the planetary seeker, because of its field-of-view limitations.

Real-time telemetery will be transmitted from the spacecraft from soon after injection, continuing during the remainder of the trajectory to and during the Venus flyby, when bulk of the data collected will be stored in a memory unit having a capacity of the order of one million bits. These stored data will be relayed to earth during the next two days as the spacecraft continues its trajectory for an orbit around the sun.

Three nets will be involved in the Venus experiment—JPL's Goldstone facility will be the focal unit, transmitting commands to the spacecraft, with both the Woomera, Australia and Johannesburg, South Africa stations participating in the tracking operation. If any advantage is seen in transmitting from either Woomera or Johannesburg, they also will be used for command operations.

Because of the escape speed and the trajectory for the Venus flyby there is practically no chance of the spacecraft impacting on the planet, an action which would result in far less data than the flyby operation could afford. There is no possibility of orbiting the planet, since retrorockets will not be included on the spacecraft.

Mariner Participation

Although Mariner A is a Jet Propulsion Laboratory in-house program, perhaps 75-80% of the effort will be performed by industry participants, for the supply of off-the-shelf items or for the development and construction of new components.

Subcontractors to JPL on the Mariner A program include:

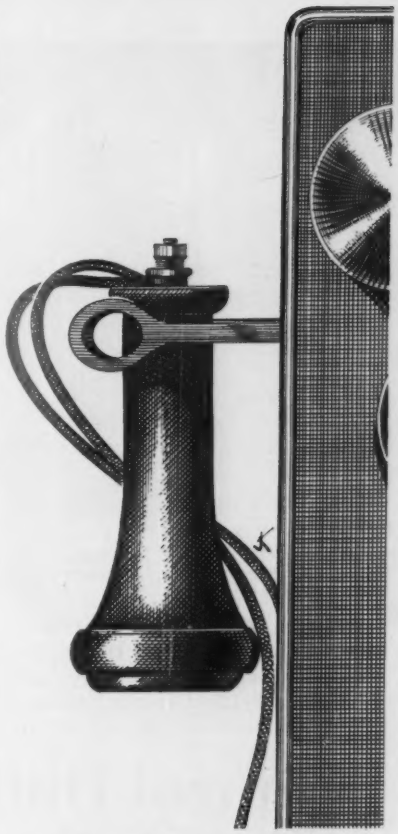
• **Scientific instruments**—Space Technology Laboratories, Ewen Knight Corp., Computer Control Co., Inc., Marshall Laboratories, Electro-Optical Systems, Inc., Massachusetts Institute of Technology, University of Maryland, State University of Iowa, and University of Chicago.

• **Spacecraft systems**—American Electronics Corp., Texas Instruments, Inc., Hughes Aircraft Co., Motorola, Inc., Northrop Corp.'s Nortronics Division, Bell Aerosystems Co., General Precision's Kearfott Division, Spectrolab, Inc., Ryan Aeronautical Co.'s Aerospace Division, Ampex Instrumentation & Computer Products Co., United Shoe Machinery Corp., and Barnes Engineering Co.

Air Force Building Hypervelocity Range

Air Force Systems Command has started construction of a 1,000-ft. hypervelocity pilot range which will accommodate 2.5-in. diameter projectiles fired at re-entry velocities.

Facility will be located at the Arnold Engineering Development Center and will be used for wake geometry, microwave transmission and meteorite impact studies.



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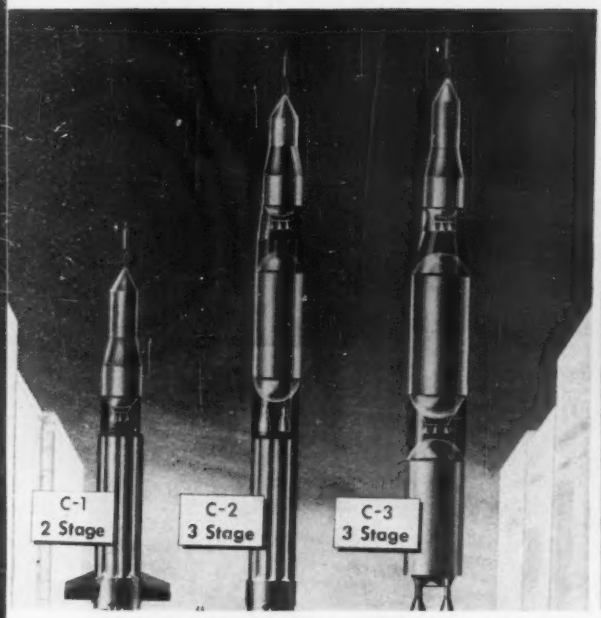
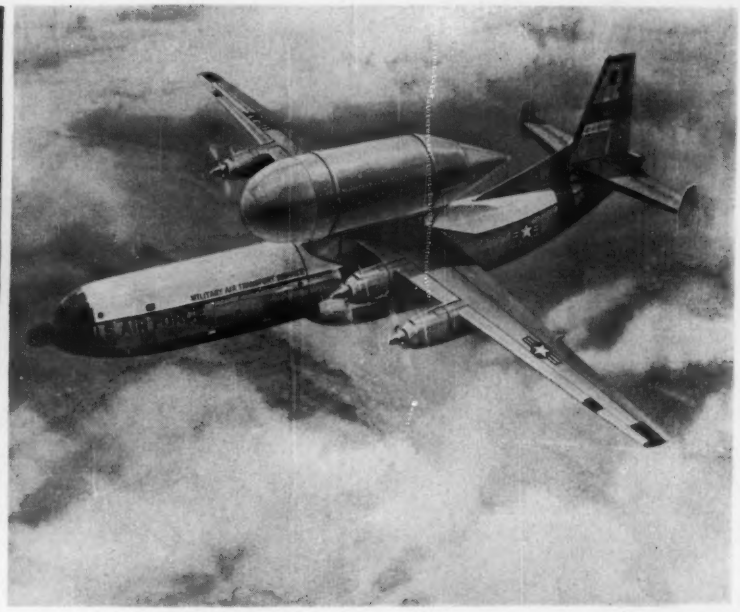




MARSHALL SPACE FLIGHT CENTER now is proposing that the Saturn C-3 configuration be used with two F-1 engines as the booster stage. Earlier concepts were based on a cluster of eight H-1 engines. The C-3 second stage would be four J-2s; third stage would be a cluster of six LR-115 engines. Douglas C-133 is being considered as a ferry for Saturn stages (right). Drawing shows an S-IV upper stage, with aerodynamic fairings fore and aft, as it might be carried on top of the modified transport.

Control Duties Foreseen for Space Crews

By Erwin J. Bulban

Tulsa, Okla.—Increasing need for reliance on the heritage of aircraft industry experience to provide optimum design of manned space vehicles was indicated here at the first conference on the peaceful uses of space.

Pointing up these viewpoints was a remark by Marshall Space Flight Center Director Wernher von Braun, who said that of major significance in the Saturn/Apollo program is the elevation of the crew's role to airplane-like responsibilities with the aim being to take away some of the control functions from the blockhouse and give them back to the men in the vehicle.

National Aeronautics and Space Administration Space Task Group Director Robert R. Gilruth outlined these needs for the U. S. space flight program:

- **Aggressive development** of large launch vehicles specifically tailored to advanced manned space flight programs, exploiting aircraft experience in flightworthiness requirements and techniques.
- **Development of advanced boosters** for future space flight programs, keeping in mind that man is to be a vital component of those missions. These boosters should be tailored from the start to the accommodation of man.

The use of modified Redstone and Atlas launch vehicles in Project Mercury has imposed severe restraints on manned spacecraft design and operation because of limitations on weight-lifting capability and reliability, Gilruth pointed out.

He said we must face up to such challenging tasks as providing vehicles with trajectory parameters that reflect man's physiological limitations, prelaunch procedures that facilitate late insertion of man into the spacecraft, a simplification of operations that will improve ability to launch at the specified time, and a new high order of safety and reliability. As to the latter, Gilruth indicated that greater emphasis must be placed on the application of redundancy concepts to critical launch vehicle components in the manner that has served so eminently in the aircraft field.

Detailed consideration should also be given to the use of flight crew monitoring and control where such measures can improve launch phase reliability, he said.

Large Launch Vehicles

Advanced launch vehicles with greatly increased weight-lifting capability will provide no easy brute-force solutions to future problems, Gilruth stated, since the desire to take on advanced missions has always placed a very high premium on weight control and system sophistication. Design of the Apollo spacecraft will entail a weight limitation problem that forces a hard look at the primary objectives to determine what compromises must be made.

"We cannot permit old concepts to dominate the configuration design, unless they pay their way in the accomplishment of the basic space mission," Gilruth noted. Design of the Apollo must cater to the maximum of space mission capability, incorporating only an optimum configuration compromise for launch, re-entry and landing requirements.

"We therefore are compelled to relegate conventional landing capabilities to a lesser importance unless they can be provided with little penalty to overall mission performance," he said. Gilruth indicated that one concept that would obviate need for a "conventional

Comsat User Costs

Tulsa, Okla.—System of communications satellites will be meaningful for the U. S. Information Agency only if it is a cheap system, the agency's director Edward R. Murrow, told scientists, engineers and businessmen attending the first conference on peaceful uses of space here.

"We cannot squander millions for the novelty of using a new satellite system," Murrow stated, adding that in his opinion satellite communication will not be a completely new system of communication, but an additional one.

landing system"—such as the Mercury parachute recovery system—is the Rogallo flexible wing glide configuration.

This stowable-type wing, of the same order of weight as a parachute, would make it possible to utilize an optimum configuration for the space and re-entry configuration and still provide a horizontal pilot-controlled landing capability on land or water. Such a wing with a lift-to-drag ratio of approximately five, could be deployed after re-entry to permit final selection of the landing area, Gilruth added.

In the conduct of this nation's space flight program, there is much to be learned and it can be expected that mistakes will be made, Gilruth noted. He said that there is a wealth of valuable experience available that could do much to increase the pace and success of the national space program "if it could be ferreted from the unreported recesses of our many projects and effectively disseminated to other project groups." Gilruth said he did not mean to imply that there has been willful withholding of such data.

Design Criteria Handbook

A possible mechanism for overcoming this major information handicap might be something along the lines of that used in the aircraft field—a space counterpart to the handbook of design criteria used by airframe engineers, he indicated. A skilled handful of specialists working full-time developing design criteria for space vehicles is badly needed, Gilruth stated.

Space Systems Division Commander Maj. Gen. O. J. Ritland remarked that "it is imperative" that we improve our index of reliability, that we develop maneuverable vehicles capable of airplane-like landings at pre-designated points and that we enhance our capability to recover at high speeds. Only flight-test programs can provide data on problems encountered above ballistic missile re-entry speeds, Gen. Ritland stated, noting that a NASA manned lunar vehicle proposed for the latter part of this decade will attain speeds of Mach 37 and will be designed to survive the higher re-entry speeds that such performance dictates.

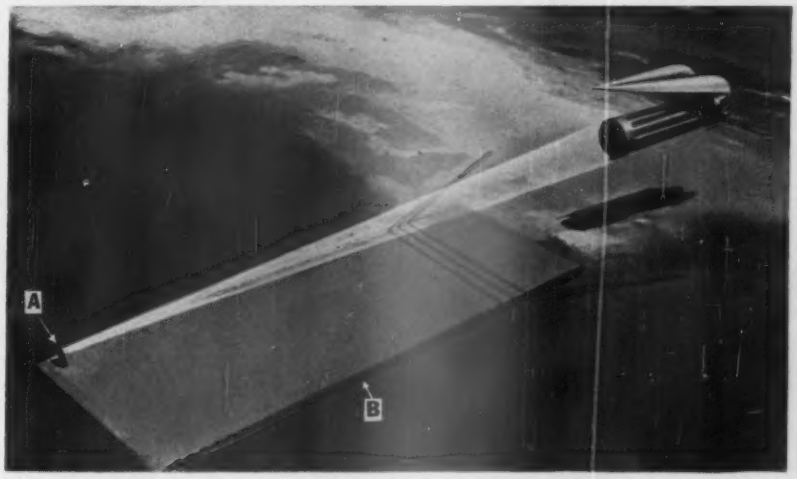
Additional reference to reliance on airplane-like techniques was made by General Dynamics Astronautics Division Manager J. R. Dempsey, who noted that an advanced booster concept under development by Convair for over a year and a half employs a "single-stage-to-orbit" principle, with horizontal takeoff and landing characteristics. Crew would control the system from takeoff, from a runway, probably turning the flight system to automatic control for the trajectory-to-orbit flight phase. Crew would take over control again to assist the automatic system in a space rendezvous and would also be in command during recovery and landing. This concept would be operational in the 1970's, Dempsey indicated.

Discussing the "whole stable-full" of new rockets, with which he expects we will overtake the Russian thrust superiority by a good margin, von Braun lifted the curtain slightly to reveal additional detail on plans for the Saturn C-3, which does not yet have full NASA approval, and on Nova-class projects:

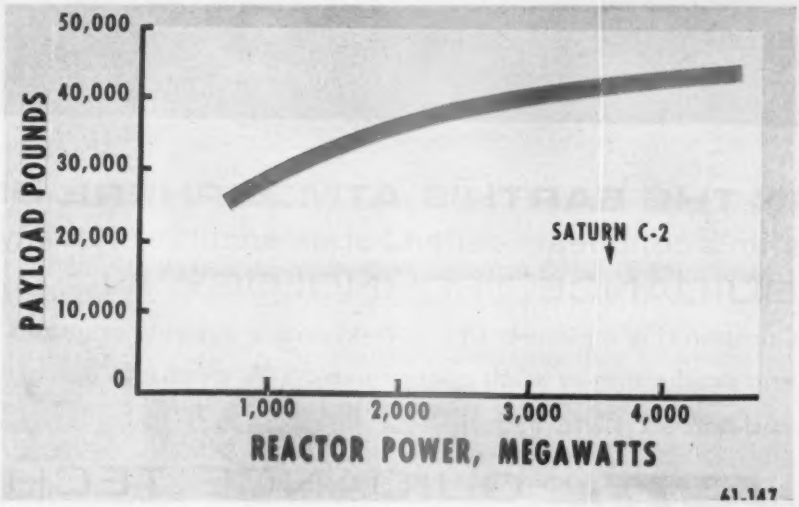
• **Saturn C-3** is designed for a first stage consisting of two Rocketdyne F-1 engines, each of 1.5 million pounds thrust, providing twice the power of Saturn C-1 and C-2 first stages, which are made up of a cluster of eight Rocketdyne H-1 engines totaling 1.5 million pounds thrust. The C-3's second stage would comprise four Rocketdyne J-2 liquid hydrogen engines of 188,000 lb. thrust each; the third stage is to be six Pratt & Whitney LR-115 liquid hydrogen engines of 15,000 lb. thrust each.

This thrust capability would allow Saturn C-3 to put some 50 tons of payload into a low earth orbit, fly a multiple crew around the moon or send 12 tons of payload on a one-way trip to Mars, von Braun noted. As a measure of the capability of the C-3, a two-stage Saturn C-1 could put 10 tons of payload in a low earth orbit or three men into orbit around earth in an Apollo-type spacecraft. The three-stage Saturn C-2 is designed to put unmanned payloads of more than 22 tons in a low earth orbit, soft-land a 1.5-ton payload on the moon and return to earth, or put instruments on Mars or Venus, he said. As yet, Saturn C-3 is a Marshall Space Flight Center concept and unfunded as regards hardware.

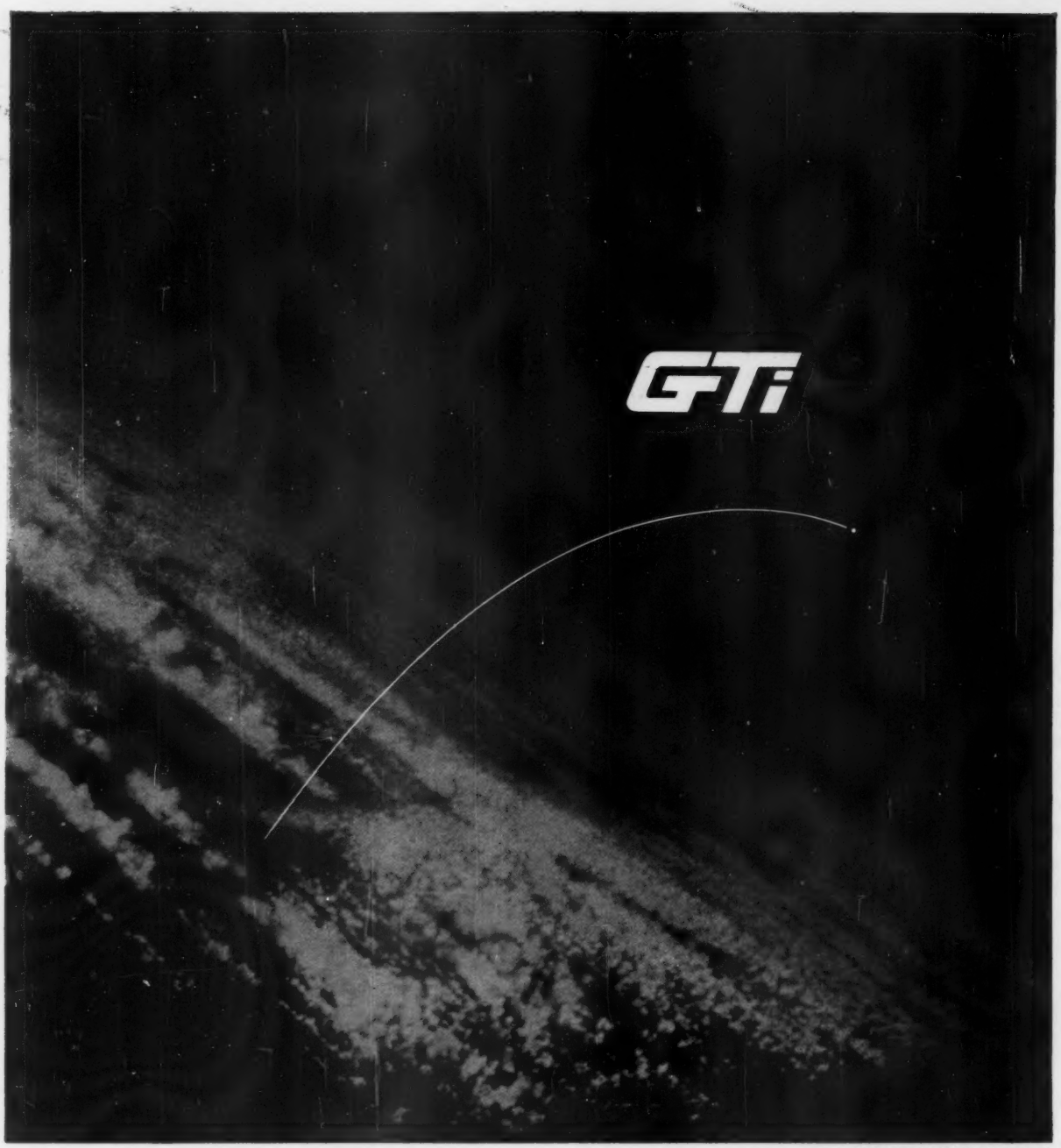
• **Two Nova versions** were discussed. One, a modular Nova with unmodified upper stages, would have as a first stage a cluster of eight 1.5 million pound thrust F-1s, two F-1s in the second stage and four J-2s in the third stage and would provide a payload capability of 160 tons in a low earth orbit or 50



ROGALLO WING to return spent Saturn tanks to the Atlantic Missile Range or to Grand Bahama Island is being studied. Guidance would be from the ground and would essentially raise and lower lines attaching the wing to the tanks.



NUCLEAR STAGE (depicted on p. 61) would give Saturn increased capability.



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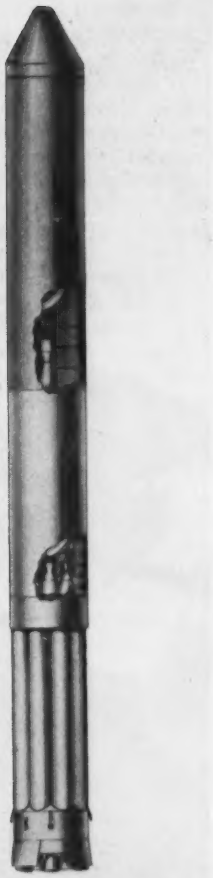

NUCLEAR SATURN is regarded by NASA as a possible Nova stage because of its potential payload.

tons on an escape course into space.

• **Modular Nova** with same powerplant arrangement as the previous type, but with additional propellant capacity for the top stage to provide a speed increase, would permit placing 190 tons in a low earth orbit or provide an escape payload of up to 70 tons, von Braun estimated. Same version could put three men on the moon and return them to earth, leaving behind 20 tons of supplies and equipment to support a lunar base, he added.

• **Nova with a nuclear** third stage could go into orbit around Mars and return to earth. "Later on . . . this class would give us the most direct approach to manned planetary and lunar exploration," he said. This version of Nova would have a first stage of eight Rocketdyne F-1s; the second stage would be either a modified Saturn C-2 booster having two F-1s or eight J-2s, with the third stage comprising two 200,000-lb. thrust J-2s. Von Braun said he expected that the U.S. would fly its first prototype nuclear rocket engine by 1965.

Von Braun noted that on the Saturn

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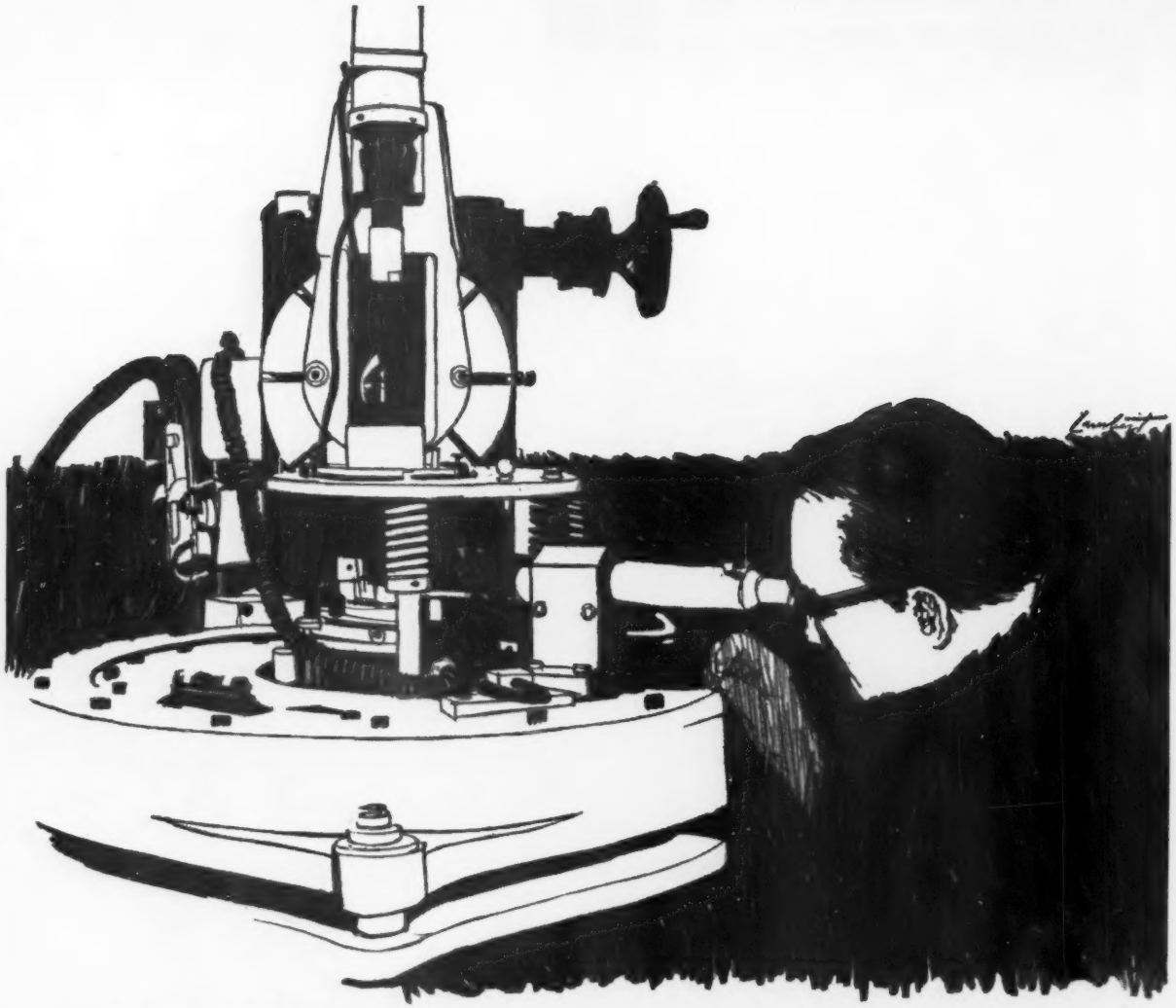

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C-1's first-stage cluster of eight H-1s, the four outer engines gimbal up to 10 deg. and all six LR-115 liquid hydrogen engines in the second stage gimbal, to provide necessary course corrections.

Possibility of retrieving Saturn boosters and some upper stages, using a Rogallo wing paraglider, was considered feasible by von Braun. Technique would be to guide the winged stage to the ground either at Grand Bahama or at Cape Canaveral, utilizing the Saturn's guidance system. Technique might involve utilizing a 300-400-mi. ballistic trajectory with a beacon in the stage being tracked by ground radar, which in turn would feed inputs to a ground-based computer to calculate energy management of the expended stage, and supply course and maneuvering information to the winged stage. Maneuvering could be accomplished by pulling lines attaching the kit to the stage in or out to adjust course as the unit approaches the landing strip. Three landing skids, attached to the underside of the recovered stage, could ease it onto an inflated pneumatic landing pad having pressure of 5-10 psi., where it would be braked by carrier-type arresting wires. Landing speed would be approximately 60 kt.

To save time in transporting Saturn stages cross-country to Cape Canaveral via water barge, a modification program entailing the Douglas C-133 turboprop transport is being studied by NASA.

One such proposal envisages carrying the big first stage atop the C-133 within a completely enclosed capsule, which could be used for other large cargo when the stages are not being hauled.

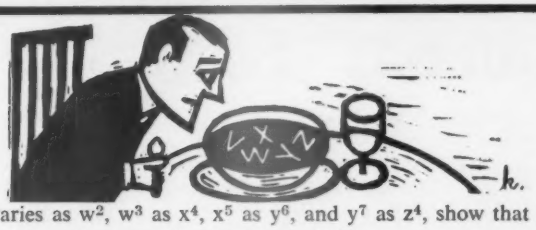
An upper-stage cargo pack would entail slight tail modification involving addition of small outer fins to provide additional stabilizing area. The proposal to carry a first stage would probably require a complete re-do of the tail to include dual fins and rudders to provide necessary stabilization and control and prevent blanketing the current single vertical tail surface.

Wind tunnel studies by Douglas and NASA indicate the feasibility of the system, according to a Douglas spokesman. Indications are that negotiations with NASA involve two flight articles and Douglas believes it could have a fully modified airplane flying a year from go-ahead.

Air shipment of Saturn stages from Sacramento, Calif., to Cape Canaveral, for example, would take some 10 hr. flying time, compared with approximately 24 days for combined barge and ship transport for a similar trip via the Panama Canal.

Von Braun noted that air shipment using dirigibles or gliders has also been proposed, but that he does not consider these as promising as the Douglas proposal.

PROBLEMATICAL RECREATIONS 70



If v varies as w^2, w^3 as x^4, x^5 as y^6, and y^7 as z^4, show that the product $\frac{v}{z} \cdot \frac{w}{z} \cdot \frac{x}{z} \cdot \frac{y}{z}$ does not vary at all. *—Contributed*

ANSWER TO LAST WEEK'S PROBLEM: He divides the bricks into 3 groups of 3, 3, and 2 bricks. Then he weighs the 2 sets of 3 bricks against each other. If they balance then the heavier brick is in the group containing 2 bricks which another weighing will simply tell. If they do not balance then he weighs 2 of the group that was heavier on the first weighing. If these 2 balance then the heavier brick was set aside. If they do not balance, then the scales tell which is the heaviest brick.

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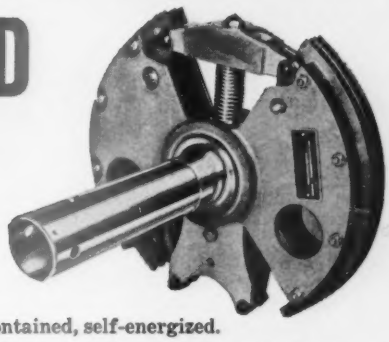

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Minuteman Vectorable Nozzle Detailed

Paramus, N. J.—Vectorable nozzle for first-stage solid-propellant motor of the USAF's Minuteman has been developed by Arde-Portland, Inc. as one of two parallel projects on first-stage nozzles for the solid-fuel ICBM.

The Arde nozzle, which passed its preflight readiness test (PFRT) nine months ago in a series of 12 static firings with 48 nozzles, weighs about 200 lb. complete, and uses less than 10% of that figure in the mechanism which moves the nozzle.

Materials are conventional, although unconventionally used. Outer shell is normalized 4130 steel with a plastic insulator and exit cone. There is a graphite core liner and a refractory metal throat section.

The two-part nozzle divides a little upstream of the throat section. Main exhaust from the propellant is directed through a parallel-sided cylindrical blast tube which straightens the flow somewhat. This tube nests over the movable nozzle skirt, matching contours along a spherical surface whose gap is filled by a synthetic O-ring seal.

Each of the array of four nozzles moves in one plane only; rotational axes are radials from the center of the array outward.

Arde's nozzle design was one of several submitted to Thiokol Chemical Corp. and the Air Force in competition for the job. First selection went to a competitor, with Arde named as backup. About a year ago, the Arde effort was moved by the Air Force from backup to parallel.

The company feels that its choice as a Minuteman subcontractor was dictated by two aspects of its approach to the problem:

• **Simple mechanical design,** which the company's chief engineer Harold Moak says was the simplest of any competing layouts. "If you designed a fixed nozzle to the same state-of-the-art," said Moak, "it would have to weigh almost the same. The mechanical design was right the first time, and we've resisted any changes to complicate it. We've only made material changes since the first design."

• **Arde-Portland's shop flexibility,** which enables it to make changes or fixes with great rapidity compared with larger organizations. "The shop has been able to crank out changes over the weekend when we needed them badly," explained Arde President Elliott Brummel. "They'd get engineers data on Friday night or Saturday by noon, and the nozzles would be fixed and shipped by Sunday night."

TECHNICIANS at Arde-Portland, Inc., install the actuators that vary the direction of the thrust vector of the first-stage Minuteman motor, above, while, below, technicians assemble and package complete unit at the main plant in South Portland, Me.

Arde's work with this type of nozzle began about four years ago under subcontract to Thiokol's Elkton division, then working on a pre-Minuteman program aimed at demonstrating the feasibility of large solid-propellant rockets, combined with thrust termination and vectoring. "Design-and-build" packages, executed under that contract, marked Arde's entry into the hardware end of the nozzle development program.

The company worked with Thiokol on early stages of Minuteman, developing a nozzle about the size required for a second-stage engine. It was a more versatile nozzle, completely gimbaled, but designed for short duration. The first units built were shipped to Thiokol's Elkton, Md. division, and fired successfully. With these nozzles, it was possible to fire, remove and replace the graphite nozzle lining and fire again.

Right after Thiokol got the contract for first-stage engines on the final Minuteman project, Arde got a subcontract for the vectorable nozzle. But the requirements were so much more severe than the earlier program work that Thiokol let other subcontracts as insurance. Air Force also let a couple of subcontracts for the same thing, so that Arde ended up in competition with

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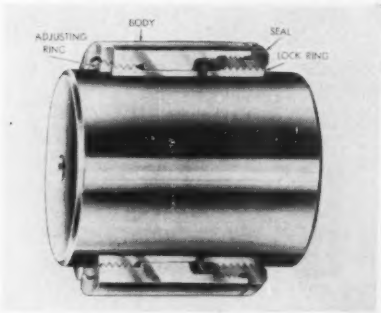

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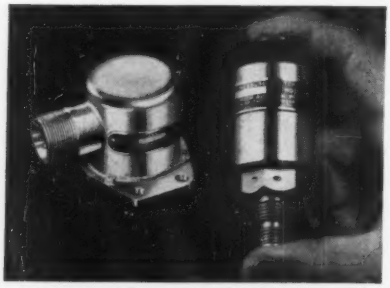

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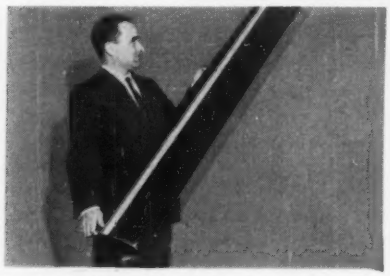

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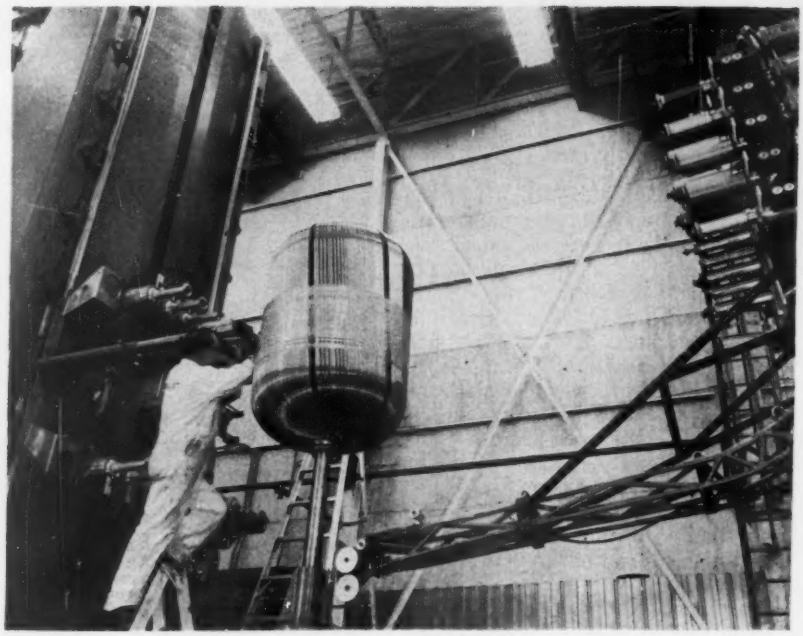
For more information check your B.F.Goodrich Aviation Products Representative, or write *Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-6A, Akron, Ohio.*



Filament-Wound Chamber Seen for Polaris A-3

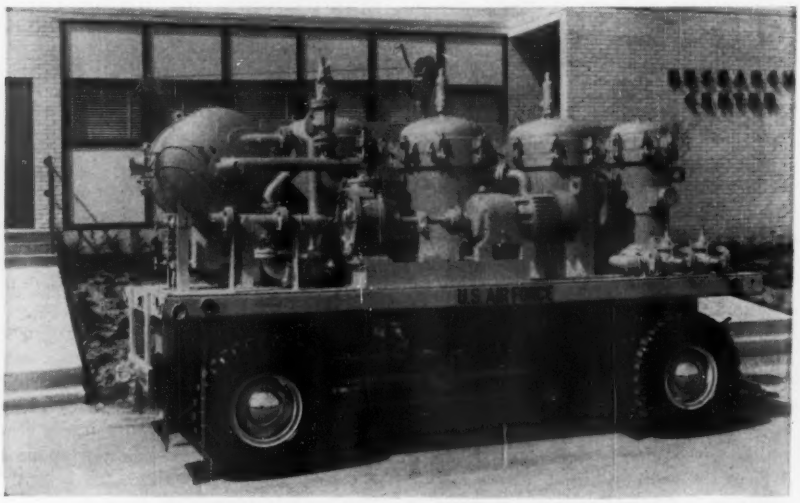
Lightweight, high-strength, filament-wound chamber for possible use as second stage of Navy's 2,500-mi. Polaris A-3 is fabricated by Aerojet-General Corp., Azusa, Calif.

Curtiss-Wright, Kelsey-Hayes, Allison Division of General Motors, Bendix and Thompson Ramo Wooldridge.

First of the nozzles to be fired was Arde's, in January 1959. But all the nozzles worked fine in Phase I work, and by April Arde was picked as a backup contractor for the nozzle. In October 1959 they got the go-ahead, and six weeks later—in December—They delivered the first unit.

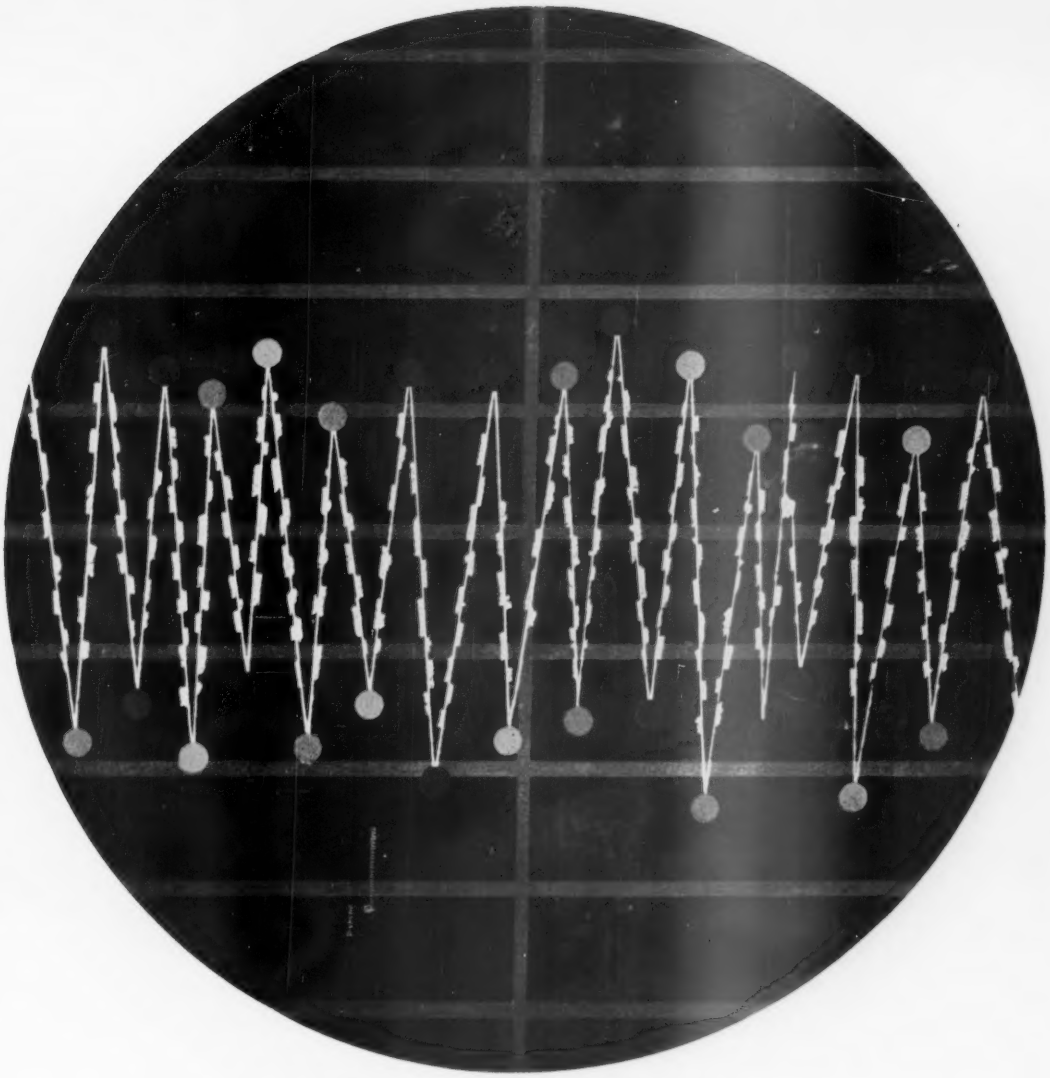
It was fired, and failed, but before failing it had stayed on longer than anybody else's nozzle, Brummel said.

Continued development with a subscale engine—one of the same diameter, but single-ported and of one-quarter the length of the full-size Minuteman first stage—found some of the faults. This work determined the need for a flow straightener, the cylindrical band added upstream of the nozzle.



Fuel Purifier for Atlas Missile

Prototype ground support fuel system for Convair Atlas missile to monitor the quality of fuel dispensed to the missile provides fuel flow rate of 300 gpm. with quality meeting USAF specification MIL-F-26678B. Major components of the system include a Warner Lewis two-stage separator/filter, desiccant dehydrators, valve system for pressure and flow control and a contaminant detector. Prototype testing and production of eight units will be completed at Warner Lewis Co., a division of Fram Corp., Tulsa, Okla., this year.



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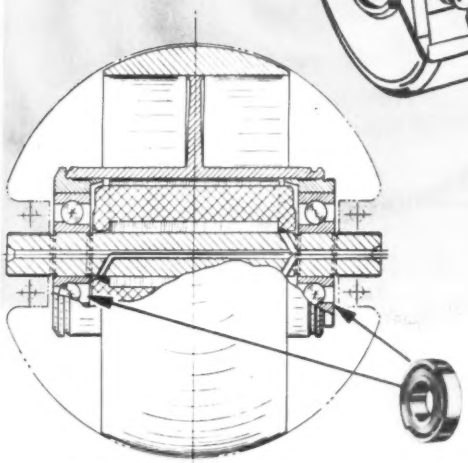

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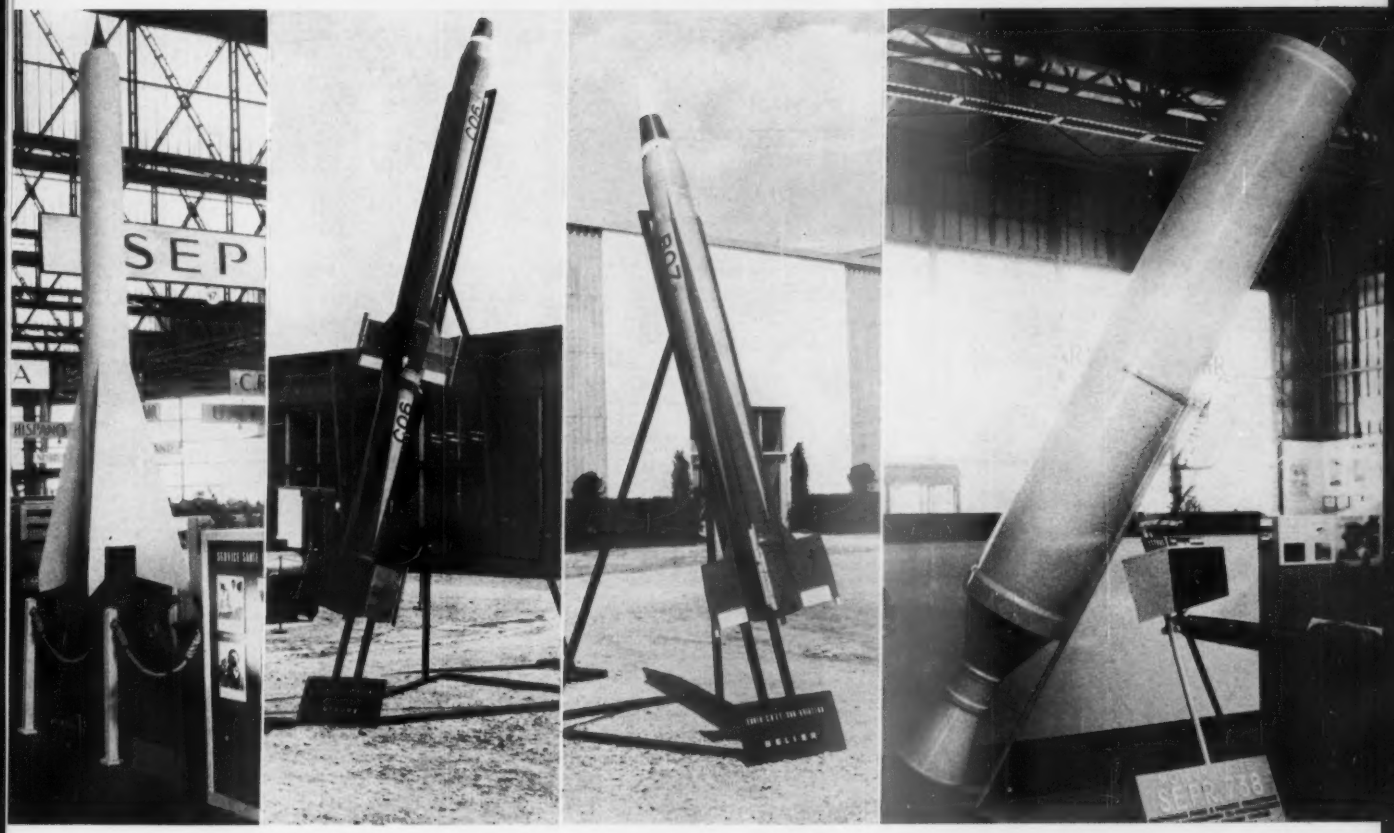
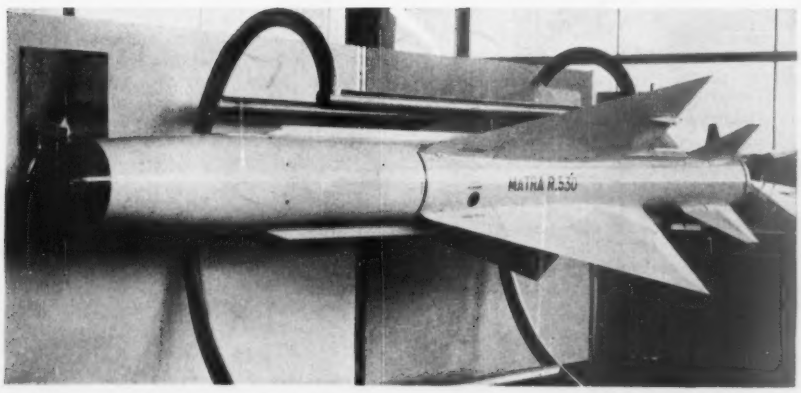
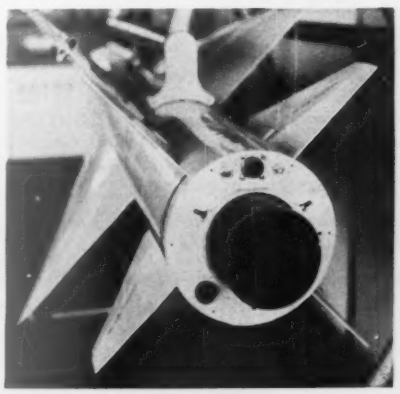


French Display Research, Combat Rockets at Paris

Stataltex experimental vehicle (left, above) was developed by ONERA, French equivalent of National Aeronautics and Space Administration, for high-altitude ramjet propulsion at speeds exceeding Mach 5. Two test models have been fired to about 32 mi. altitude. Third model, shown at 24th Paris International Air Show, is scheduled to be fired in the near future. Belier single-stage high-altitude research rocket (right center, above) displayed at the Paris show was developed by CNET, French government research organization. CNET's Centaure (left center, above) appears to be two Belier vehicles mated to gain greater altitude capabilities. SEPR 738 solid-propellant booster (right, above), for the Stataltex, produces 19,300 lb. thrust for 20 sec. before burnout. Total booster weight is 2,650 lb. Matra R.530 two-stage solid propellant air-to-air missile (below) designed as a follow-on to the Matra 511, has a range of approximately 60,000 ft. and can be equipped with either infrared or electronic guidance systems for all-weather capability. A larger first stage assures maximum initial acceleration while the second stage carries the warhead on to the target. Total length is approximately 9 ft. Photo at right below shows the rear control surfaces of the Matra 530 which control pitch and yaw motions during flight.





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Semiconductor Crisis Looms Over Pricing

By Barry Miller

Semiconductor component industry is facing a serious crisis which not only imperils the very existence of some transistor and/or diode makers but also could endanger high-quality devices required by the industry's principal users—military equipment and systems manufacturers.

Stated simply, the crisis poses the perplexing question of which way transistor and diode makers should turn to survive the chaotic price war now engulfing the industry. Pricing skirmishes have reached such proportions that the price of a single device type can sink as much as 40% in only a few hours. Large inventories of devices are being dumped on the market and some companies, willingly or not, find themselves selling products at less than cost in the hope that profits will come from higher prices on tomorrow's sales.

Semiconductor industry executives and marketing people interviewed in recent weeks by AVIATION WEEK are frankly worried, and few attempt to conceal their concern. The predicted shakeout of weaker firms may have arrived; but no one is certain who will survive.

Military users may suffer along with the suppliers, according to a number of executives interviewed. The user can be short-changed on the reliability of devices he buys during the shakeout period as some vendors cut corners to meet or better their competitors' low prices.

On the surface at least, the semiconductor component industry appears to be in remarkably good health. Its $.5-billion sales volume last year was the highest in its short history. Unit sales are steadily climbing upward, although at a curtailed rate. Estimates of the industry's projected dollar volume for 1965, made by its own leaders, range from $750 million to $1 billion. Earnings statements of publicly owned semiconductor companies looked uniformly favorable until recently.

These bright signs tend to obscure certain potentially disturbing features about this fast maturing industry, however. These features, cited by industry members and culled from available statistics, indicate:

• **Price cuts outpace cost cuts**—Prices of some transistor and diode types are dropping faster than costs. At times, devices will be sold below manufacturing costs by companies trying to dissolve large inventories, attempting to buy their way into a particular product line or to show favorable unit sales balance.

• **Dollar volume slackens**—Rate of increase in dollar sales figures for diodes and transistors has been dropping (AW Aug. 15, 1960, p. 91) even though demand continues to enlarge, reflecting sagging prices. Although the average price for military type transistors has been falling steadily since 1955 (from $11.75 in 1955 to $7.33 in 1959) —before wholesale price cutting began in transistors—according to statistics of the Electronics Production Resources Agency (EPRA) and Department of Commerce's Business and Defense Services Administration (BDSA), these reductions were more than offset by spiraling demand.

Falloff in rate of increase in dollar volume of transistor sales is reflected in Electronic Industries Assn. figures for the first quarter of this year. Factory sales (units) are pegged at 40.6 million for the January-March period, as compared with 31.2 million for the comparable period in 1960. This amounts to a handsome 30.2% device sales increase. But the dollar sales figures for these two periods are virtually identical with the figures for the first quarter 1961 at $78.5 million compared with $78.2 million for the first quarter 1960. This is an actual increase of only $224,000.

• **Productive capacity outstripping demand**—While the demand for transistors and diodes continues to soar, so

Symptoms of the Semiconductor Times

• **Sales, profits, earnings dip**—Latest quarterly earnings statement of Transitron Electronic Corp., which recorded the second highest semiconductor sales volume for the industry in 1960, reported net sales of $7,512,689 compared with $13,128,611 for the same period last year. The company reported a net loss of $698,804 for the quarter ending Mar. 25 contrasted with a gain of $2,154,216 last year. Net sales for the three-quarter period ending Mar. 25 were $31,038,990 against $35,113,222 for the comparable period of the preceding year. Earnings per share were reported at 40 cents against 80 cents and net income was $2,970,840 against $5,961,478 for the like 39-week period last year.

Dr. David Bakalar, Transitron president, attributed the relatively poor third quarter to a combination of factors including technical difficulties (since remedied), heavy startup expenses at a new 400,000 sq. ft. plant and competitive pricing. Shipments in April, however, were up sharply, Bakalar said.

• **Selling low end of production runs**—Xytan Co., newly organized division of Hughes Aircraft Co., will attempt to appeal to and work with potential customers, such as radio, television and children's toy industries, which do not need high-quality military semiconductor devices but can settle for lower-priced devices taken from the lower end of bell distribution curves of given production runs. Xytan will try to show how these devices may be used and explore with customers possible applications for them.

• **"Space age" sale**—A 60-day "space age" sale of the poorer electrical quality devices coming off the low end of bell distribution curves for different production runs was completed by Hughes Semiconductor Division on May 15. On sale were low-end silicon diodes, older fast recovery silicon diodes and diode rectifiers. An important aspect of the sale was a company effort to examine different facets of merchandising semiconductor devices.

• **Exploring microwave**—A microwave physics section was set up recently within Research and Development Laboratory of Fairchild Semiconductor Corp. to explore applications of semiconductor technology to microwave components. The microwave region was one of the first areas in which semiconductor devices were applied but it remains relatively untapped and is widely regarded as a promising direction for future semiconductor growth. Dr. Irvin H. Solt, Jr., will head the section.

• **Better customer service**—In a move to cut the user's production costs, RCA Semiconductor & Materials Division has initiated a "premium" transistor program under which it will provide the most comprehensive electrical, mechanical, environmental and life data ever offered on commercial transistors. For each lot shipped under the "premium" label a certificate of compliance will state how well the lot complies with specifications, enabling the user to reduce or eliminate many incoming inspections, according to RCA.

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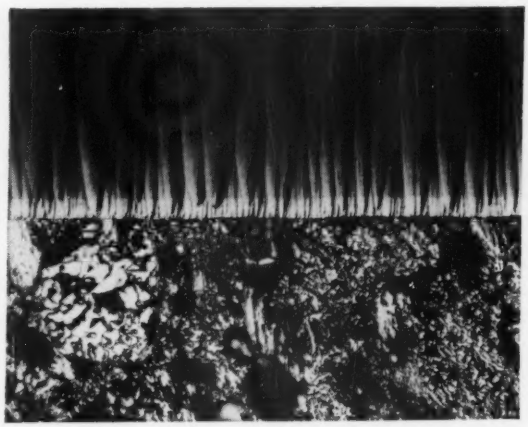

Note structural differences between ordinary graphite (bottom) and Pyrolytic Graphite (top). Ordinary graphite has crystals arranged at random with high porosity; pyrolytic crystals have high degree of orientation with no porosity.

* Pyrolytic Graphite—now commercially available—is a polycrystalline form of carbon produced by gas deposition. It exhibits a metallic behavior (high conductivity) in the planes of deposition, and a ceramic behavior (low conductivity) across the planes.

Some of its unique properties include: high strength at high temperatures up to 5000°F.; impermeability to gases and liquids; excellent thermal and electrical conductivity parallel to the plane with insulating characteristics across it; is very lightweight.

Produced as a coating on commercial graphite, it can also be built up to sufficient thickness for use as free-standing parts. Pyrolytic Graphite is well suited for many space, missile and electronic applications, including leading edges, rocket nozzles, and coatings for nose cones.

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Western Semiconductor Firms

Seven western semiconductor manufacturers are expected to account for $275 million in semiconductor sales during the current year, according to estimates in a survey by Arthur D. Little, Inc.

The seven companies and Little's estimates of their projected sales volumes are: Fairchild $30 million, Hoffman $15 million, International Rectifier $18 million, Motorola $37 million, Pacific Semiconductors $32 million, Rheem $17 million and Texas Instruments $126 million.

Estimates of sales volumes of these companies in 1960 were given in Little's report as: Fairchild $24 million, Hoffman $11 million, International Rectifier $13 million, Motorola $26 million, Pacific $20 million, Rheem $6 million, and Texas Instruments $100 million.

A number of western semiconductor device firms, including Hughes, did not participate in the survey. Hughes sales are estimated to have been between $15 and $18 million in 1960.

Little's estimates are based on interviews with executives of the seven firms and on its own information.

too does the productive capacity of the industry. A Department of Defense survey, conducted among 60 semiconductor manufacturers one year ago, reports that floor space devoted to research, development and production for these companies rose from 3.3 million sq. ft. in December, 1958, to 4.4 million sq. ft. in December, 1959, and then to 4.9 million sq. ft. in April of 1960. The survey further indicates that as of April a year ago these semiconductor companies planned expansions which would double the April, 1960, facilities by the end of 1962.

While many companies curtailed these plans in the face of impending pricing difficulties, many plans were beyond cancellation and have or are becoming realities.

A number of those questioned by AVIATION WEEK do not concur in this view of overcapacity. But even some of them will concede that the gap between productive capacity and demand is narrowing.

• **Rate of introduction of new devices** slipping—The rate of introduction of new diodes and transistors, which characteristically has been high during the first years of this growth industry, is falling off. Fewer new types of individual components are appearing on the market. This means, this argument reasons, that the new company or the smaller, more flexible shop, which could swing into production quickly, loses an advantage it had over the larger company in the days when production lines were changed frequently to handle the newer devices.

• **Number of companies continues high**—Number of companies which manufacture semiconductor devices, or have announced their intention of doing so, continues to run at close to 100. Changes are occurring, however. A handful of companies, such as C. P. Clare, have dropped out of the semiconductor business or some phase of it. Others, such as Transil, were acquired by larger firms. These in turn have been replaced by newcomers such as Kearfott, Dickson Electronics, MicroSemiconductor and Conductron. But the total number of firms in the business remains relatively large and static.

The large number means tough competition; the static number may indicate that the industry, in terms of number of companies, has hit its peak.

• **Handful of companies dominant**—About 10 or 12 companies currently divide the major share of the semiconductor business. The first 10 firms accounted for 73% of factory shipments in 1959, according to the Joint EPRA/BDSA Semiannual Survey of Production Capabilities for Electronic Parts as reported in a recent Department of Commerce Bulletin. The report does not identify the first 10 by name.

The first 10 a year later and their respective shares (in millions) of a $520-million market are Texas Instruments (100), Transitron (45), General Electric (40), Radio Corp. of America (35), Philco (30), Motorola (26), Fairchild (24), Raytheon (22), General Instrument (20) and Pacific Semiconductors (20). Western Electric, which manufactures large quantities of semiconductor components for military and internal use, may also rank in the top group.

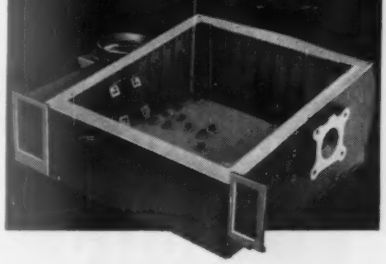
Using these estimates, based on revisions of figures appearing in a report on the Western Semiconductor Industry prepared by Arthur D. Little, Inc., one finds that these 10 companies account for roughly 70% of the 1960 sales figures. Other companies with smaller sales volumes hold strong or dominant competitive positions in specific diode, rectifier, transistor or solar cell lines.

It is difficult to arrive at a consensus among industry officials to explain what combination of factors produces the present chaotic pricing situation, but the sum of the factors—many of them interrelated—cited by these officials are:

• **Overcapacity**—There are too many firms producing and selling semiconductor devices and their total productive capacity exceeds current demands. Some officials, however, do not accept the latter part of the foregoing statement.

• **Over-investment** — Excessive venture capital has been and still is available for

Environmental conditioning *for fire control systems*



AiResearch integrated environmental conditioning of aircraft fire control systems achieves high effectiveness while reducing space and weight requirements.

Representative of AiResearch progress is this air-to-air environmental conditioning package which uses the integral heat exchanger and cold plate cooling unit as the base and mounting frame of the pressurized enclosure for the fire control system transmitter. Net weight of this unit is 9.5 lb. with a heat rejection of 425 watts.

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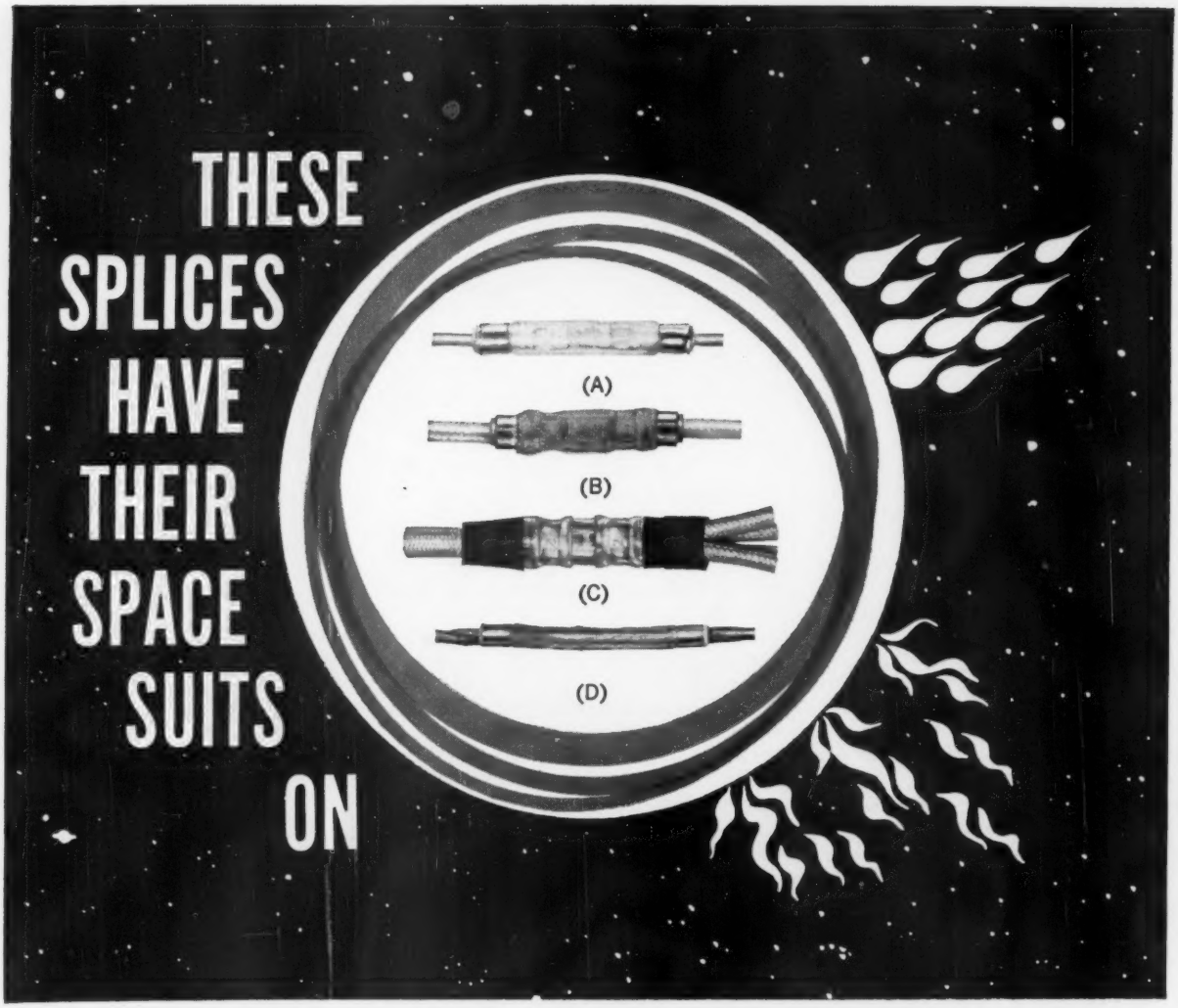

Splices in aircraft and missile circuitry must be dressed to weather the most withering kinds of high-altitude temperatures, moisture, vibration, shock, corona. AMP INCORPORATED splices **are** dressed for it, no matter what the environmental threat. High-altitude heat? AMP's **STRATO-THERM** (A) line of splices are designed to keep circuits intact at continuous temperatures to 1200°F. The post-insulated Strato-Therm splice (illustrated) has a Teflon* outer sleeve and silver-plated electrolytic copper inner sleeve, plus metal crimping rings, for full circumferential protection to solid, stranded or combination conductors. Splices available in materials to resist effects of high energy fuels compounded with Hydrazine and for connecting Chromaloy and Alumel cables. AMP's positive compression crimp insures electrical soundness. The insulated Strato-Therm splice is ideal for temperatures up to 550°F.

What about moisture breathing? The **CERTI-SEAL** (B) splice molds an all-nylon sleeve over the conductors, then compression-crimps tin-plated copper rings over the nylon, for positive moisture-proofing of more than 100 different insulation diameters. Protection for large wire sizes? The **AMPLI-NYL** (C) splice gives total nylon insulation to spliced wire in sizes #8-1/0 AWG; it will accommodate single-to-single, single-to-multiple, and multiple-to-multiple wire combinations. An airworthy splice for shielded wire? The **TERMA-SHIELD** (D) splice, for single or multiple connectors, is post-insulated with either nylon or Teflon. Conductors and shield braids are each crimped permanently and positively together, with insulation separating each conducting member. AMP is splice-conscious. It will pay you to consult with AMP where reliable space-age circuitry is the goal. Send for specific information on these AMP splices.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

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*Du Pont Trademark

backing new semiconductor enterprises. The glamor of semiconductor investment is hard to dispel when the phenomenal success of companies such as Texas Instruments and Transitron seem to be repeated periodically. Most recently Fairchild, organized only 3½ years ago, cracked into the top 10 companies with sales approaching $24 million in 1960.

The attraction of a growth industry, examples of unusual success among semiconductor firms, expanding demand for devices and until recently an apparently high profit margin combine to help secure financial backing for a new semiconductor venture. The young scientist, impatient with the slowness of his employers in exploiting his technological achievement or eager to develop the achievement in his own company, has had little difficulty in finding the necessary backers. This pattern has repeated itself so often that it is a simple matter to construct a family tree showing the former business relationships of the top technical managements in this industry.

As a result, more and more semiconductor companies sprang up, some of them quite successful and the less successful ones frequently at least capable of underselling the mother company on some specific product line. This tends to add competitors and capacity, thus driving prices down.

• **Inexperienced managements**—Usually, semiconductor component companies were founded by young technical men—often in their late twenties, thirties or early forties—with little or no business training or experience. All they needed was their knowledge of the technology at a time in the industry's growth when technical and scientific knowledge were the main ingredients of success. The lack of sound management practices or the absence of a tradition of managerial experience in a new industry didn't hurt. Few of the scientific wonders who nurtured this industry, as one businessman put it, ever saw bad times, ever had to meet a large payroll with a small bank balance or ever had to start closing sales offices.

But now the industry has matured. Efficient marketing and production know-how and sound business judgment are emerging as vital factors for continued success in the semiconductor business. This means that many of these young men must learn by doing without too many second chances.

• **Unsound business practices**—Corollary to the management question is poor business practices. As long as the vendor set prices, and often far out of line with his costs, he sometimes never knew, or certainly didn't need to know, what his costs were. With semiconductor components in short supply, pricing was established at comfortably high levels, well above the highest guess about costs.

Now the user is no longer at the mercy of his vendor either on price or delivery of components. The shrewd component marketing manager must now know precisely what his costs are.

Poor accounting procedures have and continue to result in situations in which specific devices sell for less than cost.

A marketing man playing with many variables either deliberately or in error can deceive himself into selling devices at or below costs.

Quality Factor

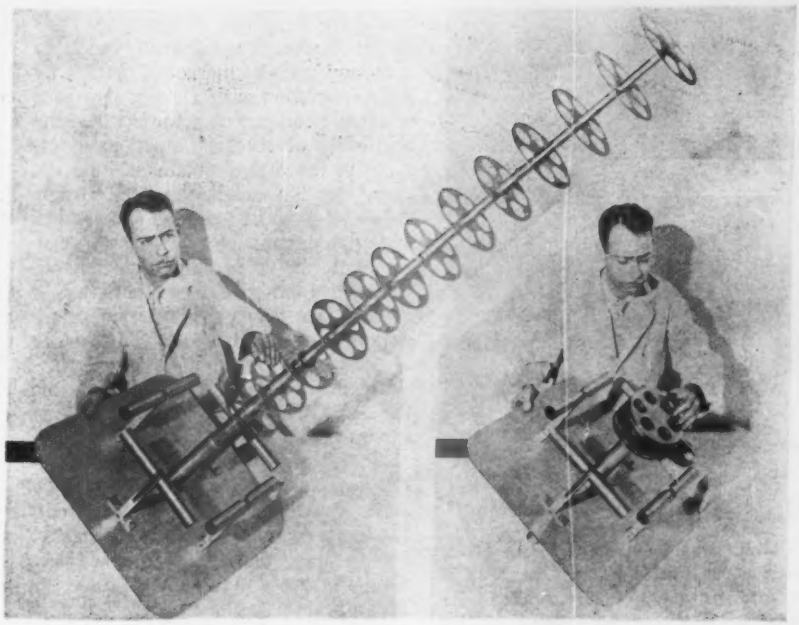
Typically, the marketing man has a bell curve distribution of the quality of devices for a given production run. Only the devices represented by the leading edge of the curve may meet stiff military specifications. Another group, represented by another portion of the curve might meet less rigid specs. Some of the remainder might be suitable for entertainment applications. Pricing is then a delicate juggling of figures—the different categories of units which may or may not be saleable, each at a different price; overhead; research and development, etc. The poorer units which he expects to sell and the income from which was subtracted from the cost of the quality units may indeed never reach a customer's hands. Or one or another of the various costs may be ignored as the rockbottom price is hurriedly figured in a long-distance telephone conversation with his representative who is about to submit a final quotation.

• **Vanishing "black magic"**—Semiconductor technology, its many nuances and the ability to make good semiconductor devices are no longer the private preserve of a few insiders. The technology is common for the industry and new developments can be imitated or repeated by competitors so that a new device with a high price tag can be quickly brought down in price as other major competitors bring out comparable units.

• **Panic**—Some companies were stampeded into slashing prices out of fear of the consequences of the changeover from the lush, high-profit days to the present intensely competitive period, according to some observers. Other producers, including those anxious to liquidate inventories, gain market position or for other ulterior motives, dropped prices, a different variation of this view reasons. Once the price cutting started, it was difficult to stop.

• **Uncertainties of military market**—Cutbacks in military spending and the on-again off-again nature of a number of military and space programs tend to confuse marketing and production plans of semiconductor firms. The military market accounts for upwards of 45% of the industry's dollar volume; a far smaller share of its unit volume.

Prevalent among many of the semi-



Collapsible Antenna Elements

Collapsible antenna elements for new line of quickly erectable antennas developed by Avien, Inc., are shown erected (left) and collapsed (insert). New Model 521A uses four-element array, operates in the 350 to 600 mc. band, measures 6 x 6 x 7 ft. when erected, 4 x 4 x 1¾ ft. when collapsed, and weighs only 95 lb. The model has a gain of 17 to 20 db., can handle over 1 kw. power and operate in 100-mph. winds, Avien says.

Ball Bearing Simulator

Ball bearing simulator, developed by Sperry Gyroscope, simulates bearing life tests in one-tenth the time previously required. Simulator can duplicate performance of any high-speed, high-temperature low-lubricant bearing such as those used in gyroscopes, motors or computer memory drums for missiles. Originally developed for company's own use, Sperry now may sell device to outside companies.

conductor industry's customers is the view that the industry's current plight—as manifested in severe price slashing—is merely the normal, healthy mechanism of supply and demand starting to make itself felt in this industry as it has in the electron tube and every other industry in a free economy. The semiconductor people may accept this, but cite factors, such as over-investment which was not characteristic of the growth period of the tube industry, that they feel deepen and aggravate the situation. Not only does it artificially add more companies to the field but the abundance of financial backers or a public enamored of electronics stocks and eager to snap up new shares may enable weaker companies to keep going.

The normal give-and-take of a free market, this view goes on, is disturbed by the "captive" or potentially captive markets which help keep companies alive. By "captive" market is meant that large share of business that a company may have tied up through agreement with an equipment manufacturer, a military agency or with its parent corporation in the case of a semiconductor division or subsidiary. Such agreements account for a major share of one of the top 10 companies' annual semiconductor sales volume. Military purchases for a single major weapon system account for over half of the sales volume for another top-10 company which is the only qualified source for the item.

While most semiconductor divisions or subsidiaries of major users do not now have "captive" markets in their parent corporations, and are quick to deny any unusual market advantage by their association with a major aerospace or avionic equipment manufacturer, the possibility of reaching such an agreement in the future remains, should the going get too tough. Such a possible liaison is suggested by the tendency of certain semiconductor firms to specialize in device types of particular application to their parent corporation.

Thus, the present semiconductor situation, this argument sums up, is an atypical one; certainly not a simple case of the unsuccessful entrepreneur closing the doors of his shop when his funds are exhausted.

The current collapse of semiconductor component prices, temporarily at least, apparently has salutary benefits for the user. Military-approved devices are cheaper, delivery is quicker, the vendor's representatives are always on call. Specification sheets are not sent casually through the mail at the user's request, as they once were, but are always available from the vendor's eager salesmen.

This buyers' market, or a variation of it, might well continue after a shakeout. The military user can always be assured that as long as his market exists, he'll be able to find companies anxious to satisfy it, component people say.

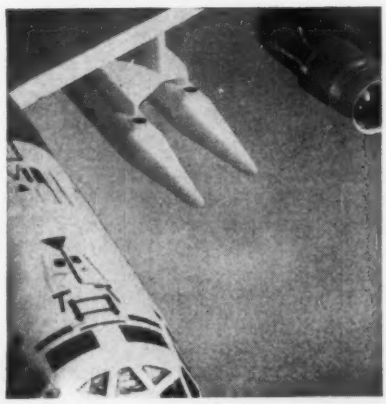
Quality May Suffer

A more frequently expressed view contends that the military user may suffer, either now or later, or both now and later. The basis for this opinion is the contention of many sources in the industry that the quality of devices will suffer. As prices are cut, the maker will cut his quality control to save money. He will risk his reputation and perhaps his business, which may already be in jeopardy, in the belief that his customers do not or cannot conveniently measure the reliability called out in the device specifications.

In addition, research and development, which have consumed large expenditures in the semiconductor industry ($70 million in 1959, $16 million of which were government funds) (AW Apr. 24, p. 81) is another expedient cost for the component maker to neglect. But this is his paradox. For this investment in research and development which bears no dividends today, and cannot help him survive now, is his guarantee for staying in business tomorrow. From research and development he can expect new products and improvements in existing components.

Hence, this view concludes the buyer may not only be pinched on reliability in today's devices but he may not get the reliability and new devices at the pace he will need

SKYBOLT



This new USAF weapon now under development will combine the range and mobility of the jet bomber with the speed and the difficult-to-detect capabilities of the ballistic missile. Yet Skybolt's warhead-carrying re-entry vehicle must operate with the same reliability and accuracy of ground-launched re-entry vehicles.

Environmental conditions—The re-entry vehicle must withstand hour after hour of vibration and noise fatigue aboard its bomber "launching pad"—the USAF B-52 and the RAF Vulcan bomber. Its heat protection system must endure repeated thermal cycling from ground take-off temperature to −65° F at cruising altitudes. If launched, it could be exposed to re-entry temperatures of 7500° F.

Extended Life—Skybolt's re-entry vehicle must have a useful life of several years, through repeated storage, thermal cycling, and return to storage—all with a minimum amount of maintenance.

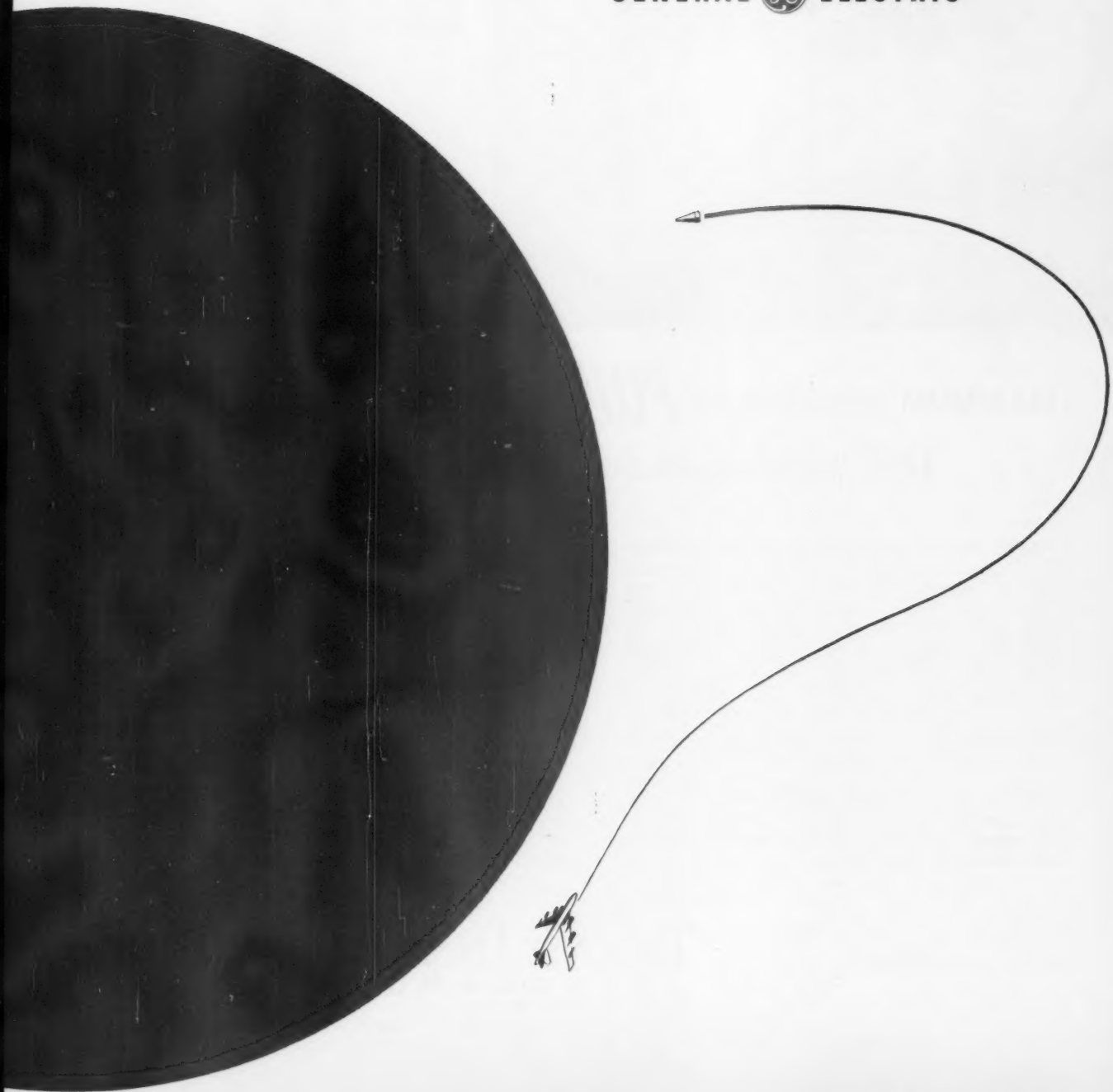
The Skybolt missile system is being developed from known and proven engineering principles, resulting in rapid program advancement at great saving to the American taxpayer. The Missile and Space Vehicle Department of General Electric's Defense Electronics Division is developing Skybolt's re-entry vehicle. 160-05

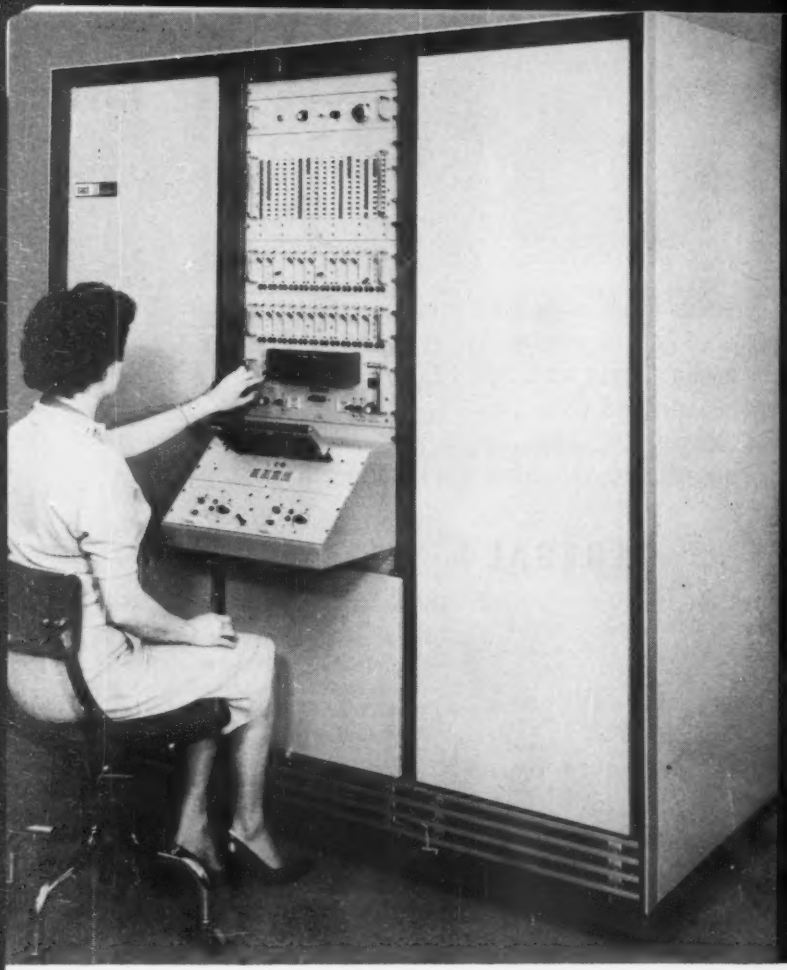
GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.

SKYBOLT is being developed to add a new dimension to America's growing missile might. Launched from an airborne B-52, it is being designed to arc through space toward targets more than 1000 miles away. The re-entry vehicles for this advanced USAF missile are being developed by General Electric's Missile and Space Vehicle Department under contract to Douglas Aircraft Company, prime contractor for Skybolt.

GENERAL ELECTRIC

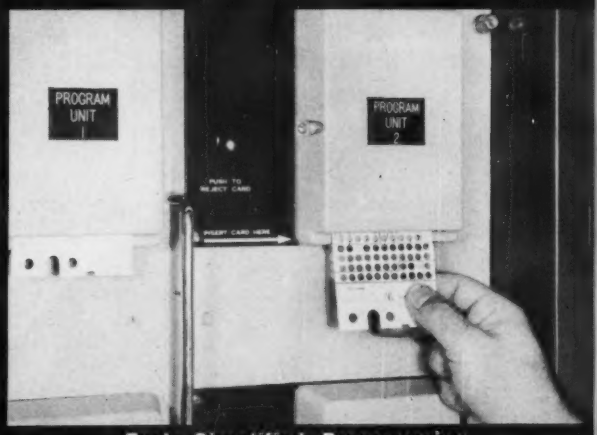




new from TI

tact

TRANSISTOR AND COMPONENT TESTER



Fast, Simplified Programming
With Punched Cards

MAXIMUM VERSATILITY *PLUS* ECONOMY

tact BUILDING-BLOCK DESIGN GIVES YOU BOTH!

TACT is a universally applicable transistor and component tester that will meet both present and future requirements without undue investment. It is a sequentially controlled system which advances through as many as 24 test parameters, applying pre-programmed test limits and visually reading out and/or recording measured results. Time-proved test circuitry is combined with punched-card programming to produce a highly accurate system of high sequential testing speeds.

TACT systems won't become obsolete—can be expanded to accommodate future tests or extended to testing printed circuit boards, modular circuits, etc.

High Testing Accuracy results from reduction of readout and signal cable leakage and interference. Test circuitry cabling has been reduced to approximately one-tenth of other designs offering similar testing capabilities.

Repeatability of Testing is maximized by punched-card programming and remote control of common test circuitry. Program cards can be retained and used indefinitely, assuring high repeatability and a permanent record of test conditions.

Nontechnical Personnel can operate TACT systems with minimum training. Reprogramming can be accomplished in minutes without circuit board or plug-in unit changes.

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them in the future if R&D funds are among the casualties of the price war.

A contrary argument, at least with respect to reliability, reasons that reliability should be and is inherent in the process of making devices. As techniques of making devices are simplified and failure mechanisms isolated and recognized, reliability will be increased. This will also lower the manufacturing cost. By improving reliability the maker lowers his cost and puts himself in a better position to compete. If the producer with the lowest costs is among the survivors he will be supplying reliable devices.

In one other respect the component user is being affected by the price war, possibly without knowing it, several marketing people say. They say that poor buying habits at the user's plant are hurting him and contributing to the depression in prices. Component buyers, this belief points out, prodded by economy drives in many companies and the buyer's desire to be a "hero" to his employers too frequently buy components at the lowest price given roughly equivalent delivery times. This enables the price cutter, who may be circumventing specified reliability, to get the business.

One example of such a situation and its snowballing consequences was cited by the marketing manager of a component firm. His company, call it Company A, shaved its price to $2.20 per device in a particular competition. Company B was low bidder, offering the devices at 90 cents each. Company A tried to dissuade the buyer from his selection, insisting that Company B could not meet the specifications at the quoted figure. Company B began delivering its devices which did in fact fail to meet the specifications.

The buyer, seeking a new source but too embarrassed to admit to Company A that he had been wrong, then approached a third company, Company C, asking it to supply the devices. Company C was told that the previous vendor sold the devices at 90 cents but was not informed that they failed to meet specifications. Anxious to get the business, Company C reluctantly took the job at the 90-cent figure.

In response to the question of what semiconductor companies must do, or have, to survive the price war, industry sources cite the following factors or combinations of them:

• **Competent marketing staffs**—Efficient, rational marketing techniques, glossed over for years in this industry, will be essential. Competent sales forces with effective selling methods must be included. Established companies with well organized distributors or sales representatives will have a distinct advantage. The need for marketing capability, which cannot easily be acquired overnight, may discourage formation of new companies and could hinder new, smaller firms.

• **Willingness to accept small,** reasonable profit margins.

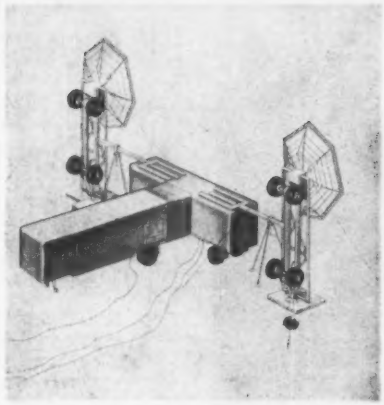
• **Research and development**—The company which hopes to survive must continue to invest in its future by stressing research and development which will lead to new and better products. Reinvesting a good share of its profits in R&D may hurt today, but many feel this is the key to the semiconductor industry's crisis. Here again the small producer, who may have to skimp and cut corners and must sacrifice R&D, will be the loser.

• **Select product role**—Companies seeking to remain strong industry competitors will have to broaden product lines, aim production at large volume markets. Small volume devices may have to be dropped. Another group of companies, willing to settle for the role of a specialty house—which many already are—concentrating on devices larger firms cannot make economically or are not interested in, may carve out small, comfortable markets for themselves. Most of the failures the industry expects will be among the companies which select this first role. And they may go this wrong way because of the difficulty in retrenching, the desire to maintain the post of a large company, greed or just simple bad judgment.

• **Efficient production**—Automated production machinery and the elimination of individual processing steps in the fabrication of components may enable one maker to sell products more cheaply than competitors. This should raise yields, lower costs, improve component quality and put the maker in a better position to compete.

• **Sound management practices.**

• **Systems capability**—Component maker with in-house or in-corporation systems experience may benefit when circuit functions become significant products.



Mobile Communications

Mobile tropospheric scatter communications system, AN/MRC-85, developed for Air Force by Page Communications Engineers, Inc., a Northrop subsidiary, includes two 28-ft. diameter antennas each mounted on four-wheel trailers and three two-wheel semi-trailers. Two of the latter, shown above, house and transport dual 10-kw. transmitters, quadruple diversity receivers and associated gear. Third semi-trailer, not shown, houses two 150-kw. diesel generators.

Shakeout Date Uncertain

Few people in the semiconductor industry will hazard a guess about when and how the semiconductor industry will regain its balance. The long-heralded shakeout may take place and pass within a few years—but perhaps not in the form predicted, a whittling of the industry down to seven or eight firms. Most companies around today may still be in business, but perhaps in different form. Competition in particular device types may narrow as companies elect to specialize or broaden their bases into non-semiconductor devices.

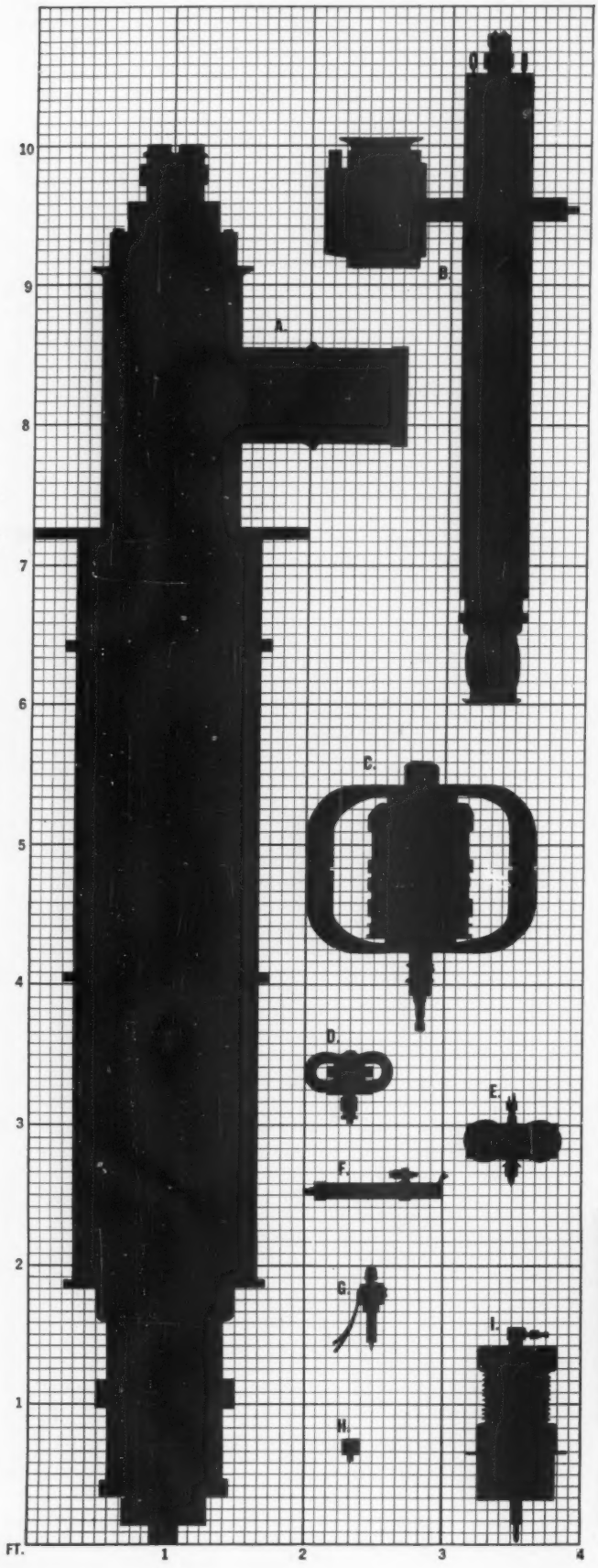
As the number of high-use military type devices shrinks, which is expected, the competition may initially be tougher but then slacken off as competitors in the high-use lines are forced out. This tendency might pinch the specialty house whose products fall into this use.

One effect current price sagging may have its make transistors and diodes, which were previously too expensive, attractive in entertainment, industrial and other fields. This could have a bootstrapping effect—broadening the use of these components and increasing the demand, but probably not enough to seriously deter current price cutting.

Hoped-for technological breakthroughs which could open new markets for individual devices (as contrasted with functional circuits) will probably not have the impact they had when the industry had a smaller financial base, according to one view. Thus, should one company develop a significantly new device which can create new demand or force replacement of older devices, it would not have the decisive impact any one of a whole series of new products had in the past several years.

New semiconductor companies may continue to arise, industry people feel, but new companies which start out being large and with the announced intention of being a key force in the industry are probably a thing of the past. This is largely true, they say, because the new company no longer has the power to create a market as it once did. If it has a good device concept, which can be made profitable, it can be duplicated by others.

Add to this all the difficulties of starting in a highly competitive market—attracting backing for an undertaking



ONE METER TO FOUR MILLIMETERS

New Litton Tubes for Air and Ground Support

A. L-3403 KLYSTRON TUBE: One of our super power line, a long pulse, power amplifier klystron for the Ballistic Missile Early Warning System, delivering 1.25 megawatts peak power output.

B. L-3270 BROADBAND KLYSTRON: A 2 megawatt L-band klystron offering long life, high peak power, 8 percent bandwidth. Other broadband klystrons, using the exclusive Litton Skirtron techniques, are available with higher power in the L through S-band region with .002-.004 duty cycles.

C. L-3455 HIGH POWER MAGNETRON: A new magnetron delivering a minimum of 2 megawatts peak power at 406-450 mc. with a .002 duty cycle.

D. L-3458 HIGH TEMPERATURE PULSE MAGNETRON: Provides long life operation at ambient temperatures in excess of 662°F. Many hours of 900°F. operation have been achieved in X-band tests.

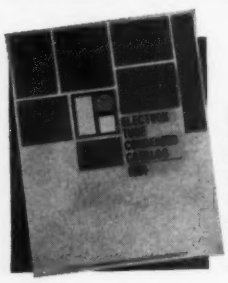
E. L-3629 FLOATING DRIFT TUBE KLYSTRON: High power, water-cooled klystron oscillator fixed tuned at 33,000-37,000 mc. Power output: 15 watts CW minimum. Other tubes available for immediate delivery from 12-4 mm. wavelength.

F. L-3472 TWT: PPM focused traveling wave tube offers higher CW power — 10 watts minimum — and wider bandwidth in a compact 3-lb. size. Operates in the range of 7,000-11,000 mc. One of a line of TWT's including a 1000-watt X-band pulse tube.

G. MICROTRON: The L-3189, one-kilowatt CW magnetron, is accompanied in package form by an electromagnet and filter assembly, high voltage and filament and isolation transformers. Only 6-second warm-up. Two year warranty for domestic microwave cooking.

H. L-3430 CUBE MINIATURE MAGNETRON: A one-kilowatt miniature magnetron, fixed tuned at 9300 ± 30 mc, weighing less than 9 ounces and no bigger than a normal X-band waveguide flange. Developments at other power levels and frequencies are planned.

I. L-3408 SWITCH TUBE: Provides switching at relatively low control voltage levels with an efficiency of 95 percent. Features high voltage holdoff, high current handling. Collector ratings: 150 Kv; 20 Amps; 10 KW dissipation.



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MICROWAVE TUBES AND DISPLAY DEVICES

once potential backers realize that this is no longer an industry with spiraling sales and big profits, the need for a quality marketing force, research and development capability, able people in scientific, engineering and management positions–and the likelihood of new companies emerging with the regularity they once did disappears.

Other signs on the horizon which could spell further trouble or provide new avenues of escape for the semiconductor component industry are:

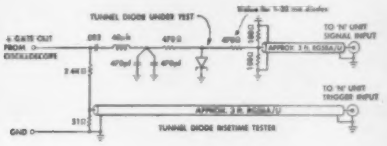
• **Foreign competition**–Devices manufactured by foreign companies and sold here currently offer a debatable amount of competition to domestic producers, but only in entertainment and possibly industrial device types. Should foreign competition step up, domestic suppliers may concentrate more heavily in military types to escape the brunt of foreign competition. Alternately, foreign makers may seek military qualification in some lines.

• **Emergence of materials supplier**–Materials suppliers are playing an increasingly active, more prominent part in processing raw materials from which semiconductor components are made. Component makers seldom grow their own crystals now and should the trend continue the supplier may offer completed junctions at attractive prices. The component maker's function then would be to attach leads and encapsulate the devices.

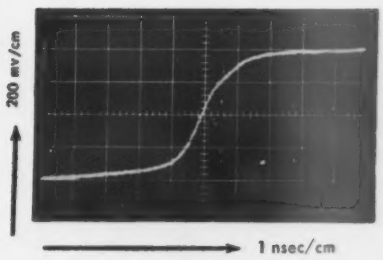
• **System maker competition**–Systems and equipment manufacturers, especially aerospace, avionic and computer firms which are volume users of semiconductor parts, are showing signs of encroaching on the component maker's territory. Many avionic and aerospace firms have their own semiconductor divisions; others, such as American Bosch Arma, are known to be shopping for semiconductor acquisitions. Still others –Lockheed, Republic, Douglas and General Dynamics–are deep in component research, in some cases semiconductor research. Small wonder that component makers, barred from membership on Electronic Industries Assn.'s microminiature parts committee which was open only to users, have protested that their competitors, systems manufacturers, are on the committee and they are not.

• **Functional circuits**–Slow but certain industry trend toward functional devices–semiconductor blocks which perform functions of a circuit rather than a component–will in all likelihood change the character of this industry from a semiconductor component to a semiconductor function industry in the future. Success with these all solid-state circuits, which employ many of the techniques the industry has acquired in the past 12 years, will inject new life into the industry, will open new mar-

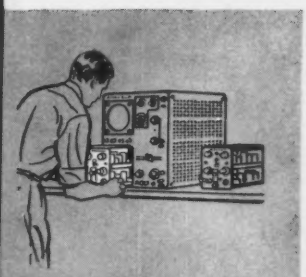
TUNNEL DIODE SWITCHING TIME MEASUREMENT


TUNNEL DIODE UNDER TEST
+ GATE OUT FROM OSCILLOSCOPE
TO 'N' UNIT SIGNAL INPUT
APPROX. 3 ft. RG58A/U
TO 'N' UNIT TRIGGER INPUT
APPROX. 3 ft. RG58A/U
GND
TUNNEL DIODE RISETIME TESTER

A convenient low-cost method of testing tunnel (Esaki) diodes with nanosecond switching speeds is shown above. A Tektronix Plug-In Oscilloscope provides both the current ramp source for the tunnel diode and the pretrigger for the Type N Unit. The N Unit is set up in the usual way — however, the oscilloscope main sweep generator is allowed to free run at 1 μsec/cm. The + GATE OUT not only triggers the N Unit but also provides a delayed current ramp with a low rate of change—which allows the tunnel diode to switch at essentially its own rate.



Typical waveform of gallium arsenide tunnel diode in Tektronix Tunnel Diode Risetime Tester.



New Type N Unit converts your Tektronix Plug-In Oscilloscope to a Pulse-Sampling Scope with a risetime of 0.6 nanosecond.

This is only one of the pulse-sampling applications your Tektronix Plug-In Oscilloscope can perform with the new Type N Unit plugged into its vertical channel. Only the Type N is needed—in addition to the oscilloscope—if the repetitive signal has a ½ to 2 volt, 45 to 200 nanosecond pretrigger, or a repetition rate from 10 to 50 megacycles.

For applications that require auxiliary equipment, Tektronix manufactures a Pulse Generator and Trigger Takeoff, a Pretrigger Pulse Generator, a Delay Cable, and many accessory items. If you have one of the dozen Tektronix Oscilloscope Types that accepts Type A to Z Plug-In Units, you already have the main component of your pulse-sampling system . . . a system that can be as simple or as formidable as your pulse-analyzing problems.

Your Tektronix Field Engineer is prepared to demonstrate the Type N Unit in your application. Call him soon.

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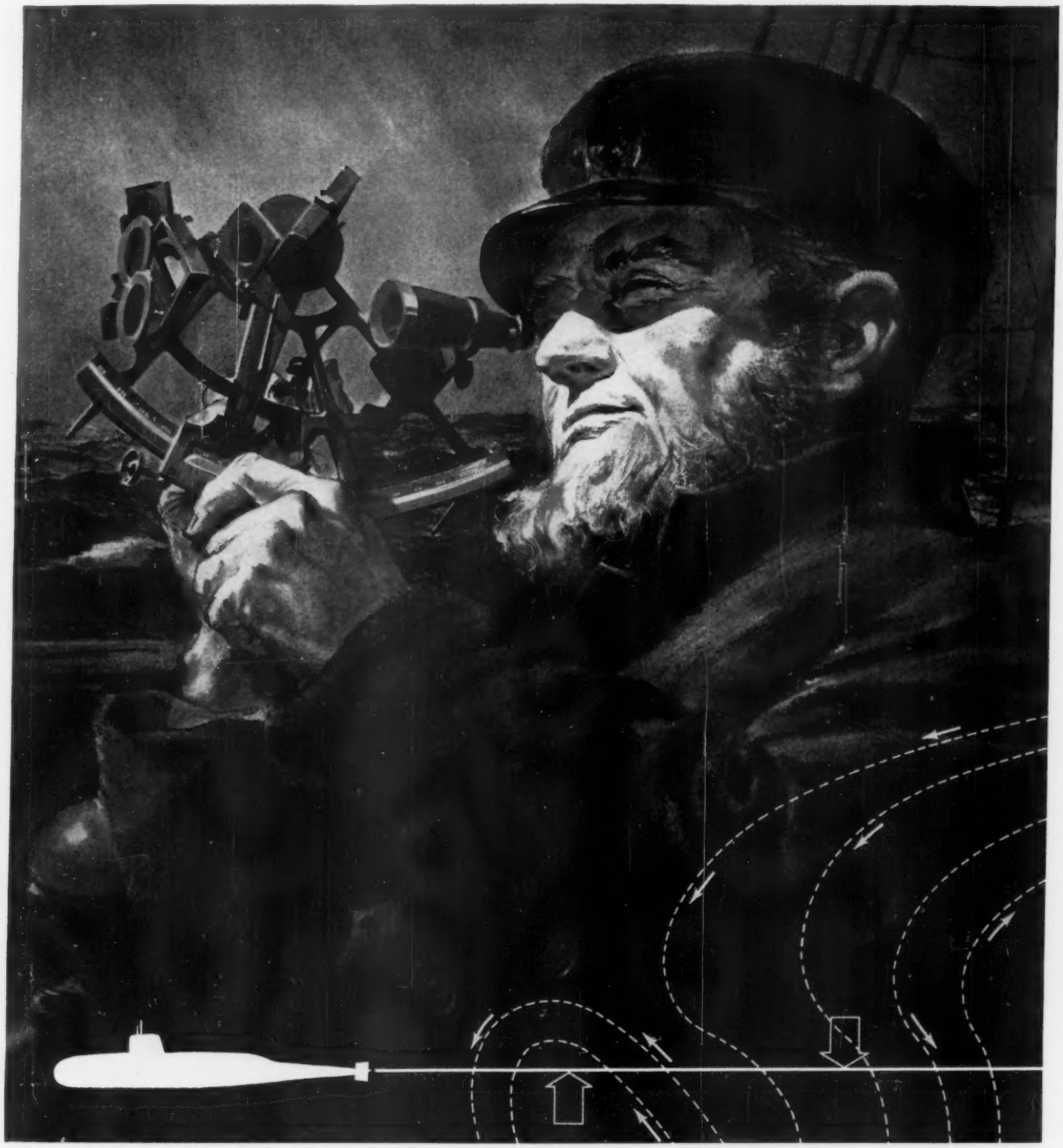

PRECISION NAVIGATION today is far from the art as it was practiced even 100 years ago. The first charts were crude diagrams with no reference to the earth. The first magnetic compass, developed perhaps over a thousand years ago, was made from a needle thrust through a straw and floated in water. These ancient methods have since evolved to celestial navigation and now inertial navigation systems that can determine a ship's position within a few feet of its actual location on the earth's surface. Nortronics — Precision Products, in developing the primary sensors in these advanced inertial navigation and stabilization devices, has contributed not only to the basic art but to setting standards of performance as well. Nortronics has unique career opportunities for scientists and engineers in advanced design, production and application of inertial gyros and devices.

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kets and tend to cancel many of the factors causing the industry's plight.

Companies intent on remaining significant factors in the semiconductor industry are pursuing this goal. The first results of many of these (Westinghouse, Texas Instruments, Fairchild, Radio Corp. of America and Philco) have been reported previously.

The ultimate solution of the semiconductor component industry's current crisis may then be postponed as the industry changes its character with a market breakthrough made possible not with new diodes, rectifiers or transistors, but by function circuits fabricated from the techniques of semiconductor technology.

FILTER CENTER

►**N-P or P-N Solar Cells**—It may be too early to decide which type of solar cell, the conventional P-N (boron diffused on N-type silicon) or the "reverse" type, N-P (phosphorous diffused on P-type silicon) is more resistant to nuclear radiation in space, according to Space Technology Laboratories' Dr. Joseph Denney, who is conducting experiments on radiation resistance of solar cells for National Aeronautics and Space Administration. Army announced last fall that N-P cell appeared more resistant to high energy radiation (four times more resistant to proton irradiation, Army said at that time) than the P-N cell (AW Oct. 17, p. 65, Apr. 4, 1960, p. 123). Army statement was based on repeatable comparison of only one N-P and one P-N cell, Denney says. He indicates that the ability of solar cell to resist radiation may be varied by a number of factors including doping level. Thus, P-N cells can be made to look as good or better than the Army's original N-P cell in their ability to withstand radiation.

►**Navy Seeks Infrared Masers**—Navy is seeking infrared optical masers for active systems capable of operating through two windows found by the Russians in the long-wavelength regions of infrared (around 39 to 41 microns). Making a maser operate at these wavelengths is largely a question of finding the right materials.

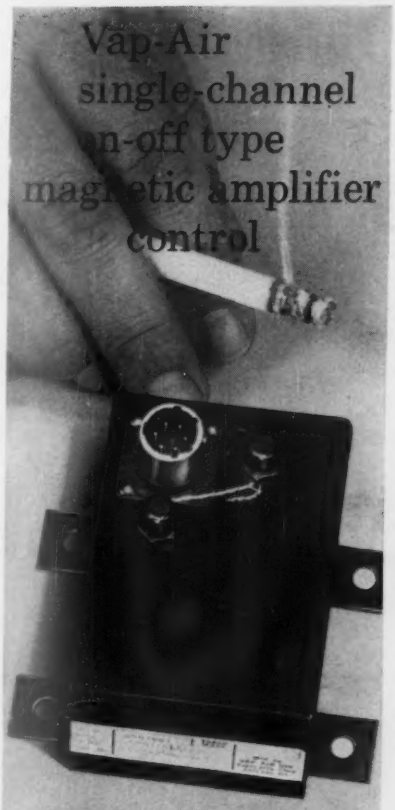
►**Thermionic Materials to Be Featured**—Materials suitable for thermionic energy conversion will be the topic of a complete session of the Third Annual AIME Semiconductor Conference to be held at the Ambassador Hotel in Los Angeles Aug. 30 through Sept. 1. Other sessions will cover thermoelectric materials and micro-electronic techniques.

►**Single Crystal Solar Cell Films**—Research and development contract for single crystal solar cell films will be awarded soon by Army's Signal Corps to one of about a dozen bidders, many of them active in solar cell work or epitaxial growth of semiconductor films. Film solar cells offer a number of potential advantages over conventional cells including use of less material and reduced weight and better utilization of satellite or space vehicle configuration. Most film research in past has been with polycrystalline films because of difficulty in growing large area single crystals and then in finding suitable substrates for them. Polycrystalline films however, cannot match the efficiency obtained with single crystal cells.

►**Saturn Launch Communications**—A 215-station voice communications network will be installed at Complex 34, the Saturn C-1 launch complex at Cape Canaveral, by Norair under a $91,967 contract from NASA.

►**Videosonics Use Grows**—Use of videosonics—a combination of visual and audio instructions—is growing in aerospace industries. Industrial Systems Division of Hughes Aircraft, where videosonics originally was developed (AW Jan. 4, 1960, p. 75), is now marketing a complete work station built around a videosonic system (tape and slide display). In addition, the Applied Communications Division of Litton Systems recently installed 20 audio-visual aids for production line guidance and training of new personnel at Litton's facility in Woodland Hills, Calif. Applied Communications was set up early last year by a group including several who had worked on videosonics at Hughes and then was acquired several months ago by Litton.

►**Tellurium Infrared Detectors**—Infrared photoconductive detectors made from single crystals of elemental tellurium and cooled to liquid nitrogen temperature (77K) approach the photon noise limit of detectivity in the 1 to 4 micron region, J. S. Balkemore of Minneapolis-Honeywell reported at a recent conference on electro-optical and radiation devices. The tellurium detectors have their peak response in the 2 to 4 micron region where there is minimum sky brightness. Typical detector time constant is 80 microseconds, reportedly shorter than the best lead sulphide detector. Resistance of 700 ohms/sq. provides convenient values for input to transistorized circuits. Tellurium research was sponsored at Minneapolis-Honeywell by Air Force Office of Scientific Research.



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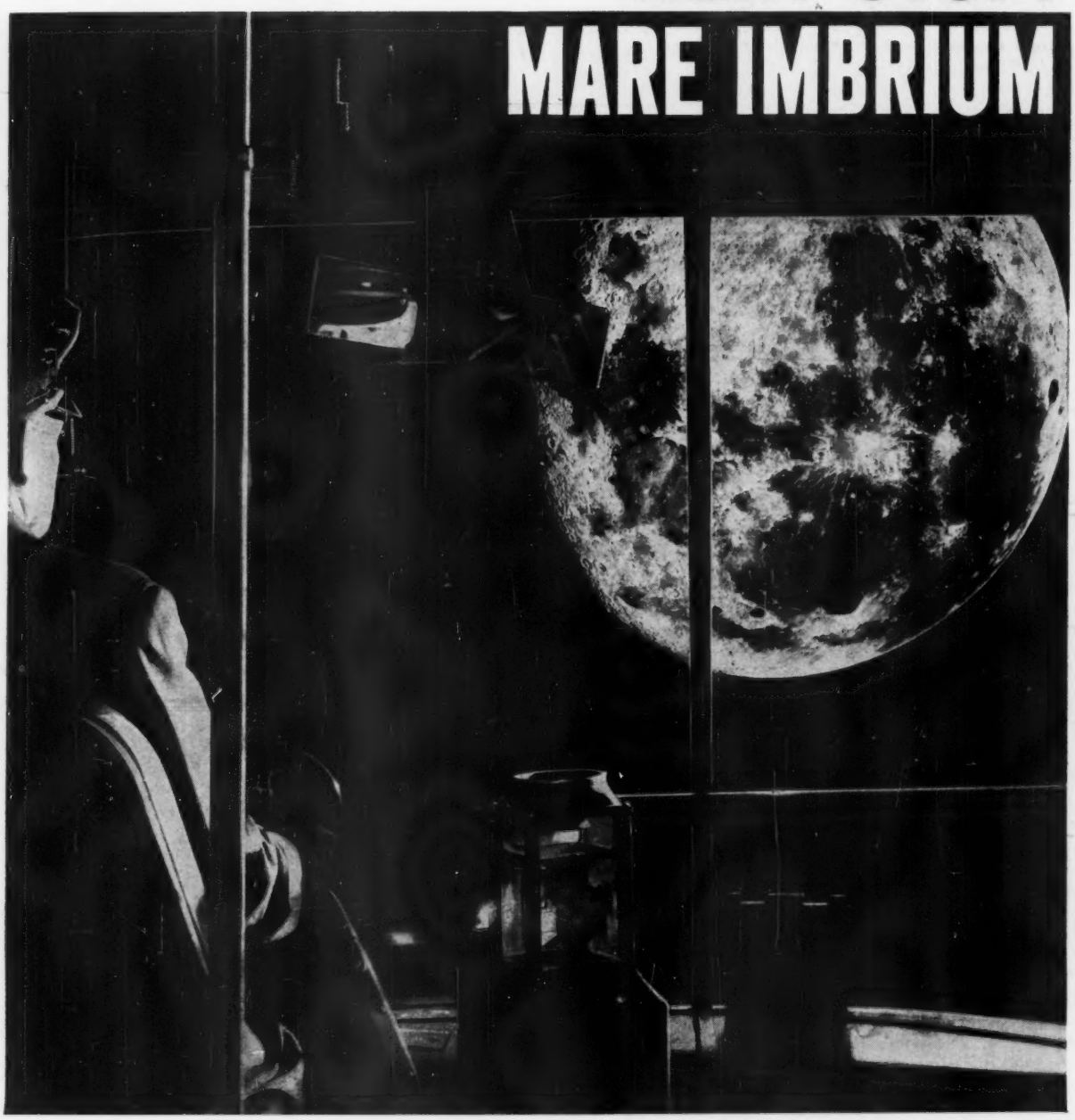

One of the primary needs in the next generation of our space program is for a reliable "space bus" to carry a variety of exploratory packages to the moon and possibly the near planets. Once it is injected into a lunar or planetary trajectory, this bus will guide itself to its destination, accomplish a soft landing, activate and release its payload.

The problems involved in the design of such a vehicle, and of the many kinds of lunar and planetary exploration packages it might be called on to carry, are being intensively explored at Northrop. These investigations cover guidance, communications and position sensing systems, thermal and environmental conditioning, structural and material development, systems integration, trajectory and error analysis, computer design, self-contained, automatic ground support systems, and a host of other essential areas.

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All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

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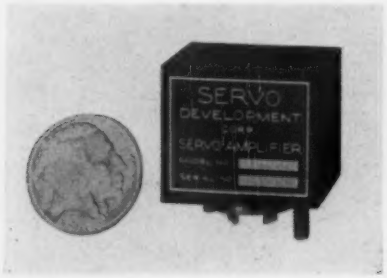
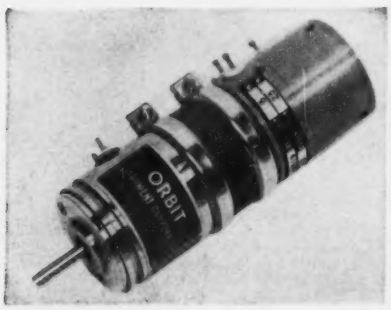
NEW AVIONIC PRODUCTS

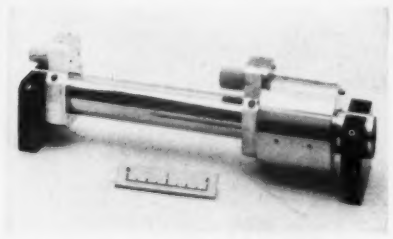
• **Miniature servo amplifier,** for operation at temperatures up to 100C., uses silicon transistors. Model 50-100 occupies a volume of 0.86 cu. in., can deliver up to 3½ watts at 40 volts rms. into



center tapped size 11 servo motor. Nominal gain is 6,500 at 10,000 ohms input impedance. Operation is from 28 v.d.c. Bulletin 13-61 gives application data. Manufacturer: Servo Development Corp., 2 Willis Court, Hicksville, L. I., N. Y.



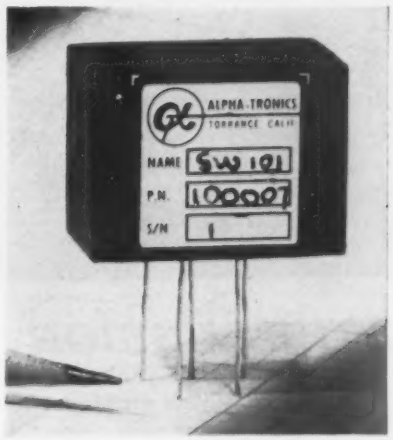
• **Magnetic-clutch potentiometer,** consisting of a size 11 magnetic clutch and spring centering mechanism coupled to a center tapped potentiometer. When clutch is energized, potentiometer can be rotated in either direction; when de-energized, potentiometer shaft is returned to within 15 min. of center-tapped position in ½ sec., or faster if needed. Clutch operates from 28 v.d.c. Manufacturer: Orbit Instrument Corp., 131 Eileen Way, Syosset, L. I., N. Y.



• **Lightweight traveling wave tube,** Type Z-3088, for operation in the seven to 11 kmc. frequency range, has noise figure of less than 15 db. with minimum gain of 35 db. and minimum power output of 5 milliwatts over frequency range. Focusing magnets are temperature compensated over temperature range of −70 to 150C. Entire assembly, including magnets weighs 2½ lb. Dimensions: 9.4 x 2.2 x 2.6 in. Price: $2,850. Manufacturer: General Electric Co., Power Tube Dept., Palo Alto, Calif.

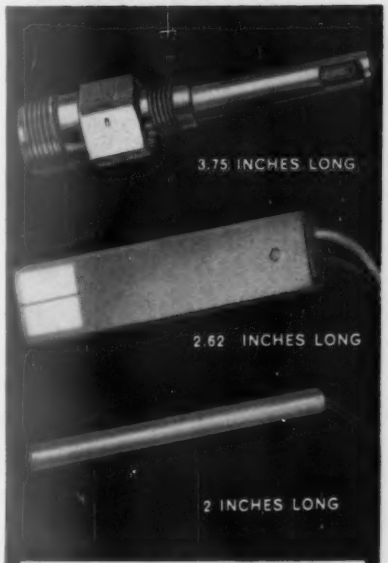
• **Piezoid ceramic material,** KE-14, for use in underwater sounding transducers and ultrasonic equipment, is available in almost unlimited variety of shapes, including disks, cylinders, tubes, plates and blocks. Dielectric constant is extremely stable, manufacturer says, over temperature range from 55 to 300C. Manufacturer: Centralab, 900A East Keefe Ave., Milwaukee 1, Wis.

• **Cryostat,** for rapid cool-down of infrared detectors to −109F, is able to drop temperature from 72F to minus 70 in one second, or down to −109F in 12 seconds, according to manufacturer, using carbon dioxide. Other models, when charged with other fluids, can produce temperatures lower than minus 109F. Cryostats are available for various duty cycles, ranging from several seconds to several days. Walter Kidde & Co., Kidde Aero-Space Division, Belleville 9, N. J.



• **Solid state switch,** Type SW-101, will switch on command at any frequency from zero to 1,000 samples per second and can handle input signals within a range of zero to one volt, with a resolution of five microvolts. Solid state switch requires no external transformer and gating power is less than 2½ milliwatts. Closed circuit impedance is less than 100 ohms. Device occupies less than 0.5 cu. in. and weighs 8 grams. Device also is available in modified form for use as a DPST switch. Manufacturer: Alpha-Tronics Corp., 1033 Engracia, Torrance, Calif.

VĀP-AIR MERC THERMOSTATS



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USAF Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by U. S. Air Force contracting offices:

HEADQUARTERS, AIR FORCE COMMAND AND CONTROL DEVELOPMENT DIV., ARDC, USAF, Laurence G. Hanscom Field, Bedford, Massachusetts.

Digital Equipment Corp., Maynard, Mass., design, construct and install a dynamic system simulator, job (RFP90562), $385,000 AF 19(604)-8067, awarded 27 Mar. 1961.

Shockley Transistor, Unit of Clevite Transistor, Clevite Corp., Mountain View, Calif., investigation and study of thin compositional layers in silicon job (RFP 151-161) $69,000 AF 19(604)-8060 awarded Mar. 27, 1961.

Allied Research Associates, Inc., Boston, Mass., investigation of particle density distribution, awarded Mar. 27, 1961, Job (RFP 148195), AF 19(604)-8384, $88,850.

Airborne Instruments Laboratory, Cutler-Hammer, Inc., Melville, Long Island, N. Y., information flow analysis of a mobile air traffic control system, job (RFP 151054 & 151054A), AF 19(604)-8370, awarded Mar. 27, 1961, $58,000.

Board of Regents of the Universities and State College of Arizona, Tucson, Ariz., research directed toward the developments of a functional lunar horizontal and vertical control system, job (RFP 129690), AF 19(604)-8064, awarded Mar. 27, 1961, $30,-000.

Rensselaer Polytechnic Institute, Troy, N. Y., research directed toward the study of the use of shallow and deep wells for earthquake and explosion detection, job (RFP 123616), AF 19(604)-8376, awarded Mar. 27, 1961, $110,300.

Trustees of Columbia University in the City of New York, New York, N. Y., research directed toward experimental and theoretical studies in seismological research, job (RFP 80629), AF 19(604)-8375, awarded Mar. 1961, $75,000.

RCA Laboratories, Radio Corp. of America, Princeton, N. J., research directed toward maximizing the performance of photoconductors, job (RFP 80826), AF 19(604)-8353, awarded Mar. 28, 1961, $84,-428.

Maxson Electronics Corp., New York, N. Y., develop and test a light TACAN transmitter, job (RFP 82331 & 82331A), AF 19 (604)-8350, awarded Mar. 28, 1961, $90,000.

Equipment Division, Raytheon Co., Waltham, Mass., study of radio wave propagation through the earth's granitic basement, job (RFP 125579), AF 19(604)-8359, awarded Mar. 28, 1961, $48,671.

The Board of Trustees of the Leland Stanford Jr. University, Stanford, Calif., research directed toward the study of the interaction of radio waves and aurora, job (RFP 130761), AF 19(604)-7994, awarded Mar. 29, 1961, $50,000.

Wiley Electronics Co., Phoenix, Ariz., conduct theoretical and experimental investigation leading to the design and experimental construction of a broadband line source illuminator, job (RFP 158919), AF 19(604)-8385, awarded Mar. 29, 1961, $58,585.

Stavid Division, Plainfield, N. J., reengineering of the Sferics Locating System AN/FMS-3, job (RFP 130535), AF 19(604)-8415, awarded Mar. 30, 1961, $39,920.

The University of Chicago, Chicago, Ill., construct hydrodynamical analogues of atmospheric behavior in order to ascertain the mechanism and cause of fluctuations in the general circulation of the earth's and other planetary atmospheres, job (RFP 160307), & (160307A), AF 19(604)-8361, awarded Mar. 30, 1961, $60,000.

Gilfillan Brothers Inc., Los Angeles, Calif., investigation of digital/hybrid ATC aids for mobile RAPCON controllers, job (RFP 93636), AF 19(604)-8363, awarded Mar. 29, 1961, $89,962.

Missile and Space Division, Lockheed Aircraft Corp., Sunnyvale, Calif., design and fabricate spectrometers for the measurement of high energy protons in the Van Allen belt, (RFP 130,793), AF 19(604)-8028, Mar. 8, 1961, $91,972.

Lockheed Aircraft Corp., Burbank, Calif., investigation of effect of communications and navigation satellites upon EMS concept and design, job (RFP 151-056 & A), AF 19(604)-8074, awarded Mar. 7, 1961, $55,-018.

Northeastern University, Boston, Mass., theoretical and experimental research on "Statistical Communication Theory", job (RFP 125674), AF 19(604)-7494, awarded Mar. 10, 1961, $85,000.

HEADQUARTERS, ELECTRONIC SYSTEMS DIVISION, AIRFORCE SYSTEMS COMMAND, USAF, Laurence G. Hanscom Field, Bedford, Mass.

Research Center, International Business Machines Corp., Yorktown Heights, N. Y., research directed toward realization of general-purpose machine, (RFP 131733), AF 19(604)-8449, awarded April 17, 1961, $34,227.

The Trustees of Columbia University in the City of New York, New York, N. Y., research directed toward the study and measurement of the motion of the deep ocean floor in the frequency range of seismic waves (RFP 130892) AF 19(604)-8357, awarded April 17, 1961, $173,120.

Technical Operations, Inc., Burlington, Mass., investigation of thermal radiation from nuclear weapons and possible geophysical effects (RFP 123567) AF 19(604)-8436, awarded April 18, 1961, $65,900.

Lowell Technological Institute Research Foundation, Lowell, Mass., design, construction and testing of sferics detection and locating equipment; processing and tabulation of data (RFP 81380) AF 19-(604)-8429, awarded April 20, 1961, $38,-234.

Friez Instrument Division, The Bendix Corp., Baltimore, Md., design and fabrication of rocketsonde as a payload for a rocket sounding system (RFP 130873) AF 19(604)-8433, awarded April 20, 1961, $65,-502.

Stanford Research Institute, Menlo Park, Calif., research directed toward the determination of ionospheric reaction rates by the use of estimating analyses and reduction techniques (RFP 126685) AF 19(604)-8355, awarded Apr. 6, 1961, $58,800.

Electronic Communications, Inc., Timonium, Md., research and development of UHF ferroelectric phase shifter research (RFP 126040) AF 19(604)-8379, awarded Apr. 5, 1961, $30,458.

Stanford Research Institute, Menlo Park, Calif., experimental and theoretical investigations directed toward arrays with unequal element spacing (RFP 130640) AF 19(604)8059, awarded Apr. 6, 1961, $49,988.

Allied Research Associates, Inc., Boston, Mass., prepare failsafe design and specifications for storing and handling an FS mixture for servicing B-58 and B-70 aircraft (RFP 130541) AF 19(604)8383, awarded Apr. 3, 1961, $32,282.

National Company, Inc., Malden, Mass., research study of the use of pulse doppler radar for measuring wind velocities (RFP 130883) AF 19(604)8340, awarded Apr. 4, 1961, $30,710.

Research Institute, University of Oklahoma, Norman, Okla., the absorption of supersonic elastic waves in solid bodies and in granular media (RFP 123618) AF (19-(604)8416, awarded Apr. 5, 1961, $66,848.

Burns and Roe, Inc., New York City, N. Y., development of storage and handling system for chlorosulfonic acid in a B-52 aircraft (RFP 130537) AF 19(604)8338, awarded Apr. 4, 1961, $96,926.

Geo Sciences Division, Texas Instruments Inc., Dallas, Texas, research directed toward the development of an automatic marine seismic monitoring and recording device (RFP 130891) AF 19(604)8368, awarded Apr. 6, 1961, $268,205.

Geophysics Corp. of America, Bedford, Mass., investigation of mid-course recognition techniques, (RFP 130233), AF 19-(604)8451, awarded April 24, 1961, $97,039.

Rescon Electronics Corp., Waltham, Mass., design, fabrication, installation and testing of a solid state radar data processor, (RFP 160650), AF 19(604)8479, awarded April 25, 1961, $95,236.

For engine bleed-air shut-off. Fast action, tight closure. Low weight-to-size ratio. Compact, simple design . . . only one moving part. Valve shown operates from sea level to 25,000 feet, at duct pressures from 4 to 35 psig; duct temperatures from −65° to 460°F., ambient temperatures from −65° to 350° F. Other models for temperatures to 850° F. and altitudes to above 60,000 feet.

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2 DIFFUSION BARRIER, stable carbide interface, prevents diffusion of carbon into tungsten and eliminates gas pockets between liner and heat sink.

3 GRAPHITE HEAT SINK provides rapid absorption of heat from liner into graphite. Shape is a function of application requirements.

4 CERAMIC INSULATOR presents a high-temperature thermal barrier to restrict heat transfer into plastic insulation.

5 PLASTIC INSULATION serves the dual purpose of preventing overheating of outer wall and adds rigidity to the system.

6 FLANGE AND SPLINE ASSEMBLY of high-strength alloy provides axial load distribution and allows nozzle to be assembled from the inside out.

7 OUTER SHELL of filament-wound plastic provides maximum efficiency on strength-density basis.

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Marquardt's unique ability to produce intricate components and systems for the aero-space and defense industries is substantially supported by company sponsored research programs in manufacturing operations. New levels of efficiency and economy in fabricating techniques are tangible results of these programs. Development studies are presently being conducted in high-energy forming of tungsten sheet into radical shapes impractical to form by standard processes; in improving techniques in welding pure tungsten sheet; in producing spin forged tungsten castings and forgings on a high-volume basis.

Significant materials and manufacturing achievements at Marquardt include the development and production of spun tungsten rocket nozzles; a wide variety of nozzle liners and parts; fixed and variable afterburner nozzles; complex attitude propulsion systems and controls; and ramjet nozzles.

Sixteen years of technological experience gained in research, development, and production of a broad range of power systems for atmospheric and space flight are important benefits offered by Marquardt engineers. This leadership combined with extensive facilities provides an exceptional capability for the development and production of reliable high-temperature materials and structures. Detailed information about Marquardt's advanced manufacturing capability may be obtained by writing Corporate Director-Marketing, The Marquardt Corporation, 16555 Saticoy Street, Van Nuys, California.

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CORPORATE OFFICES, VAN NUYS, CALIFORNIA

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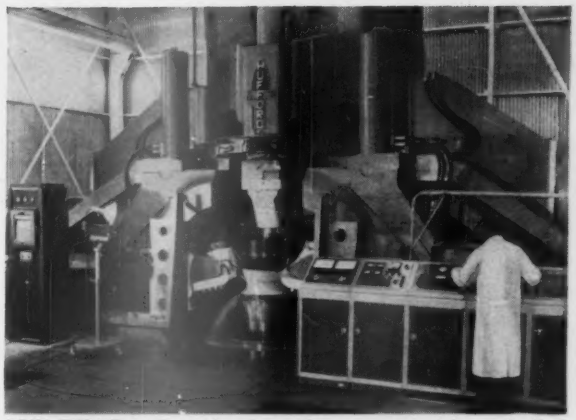

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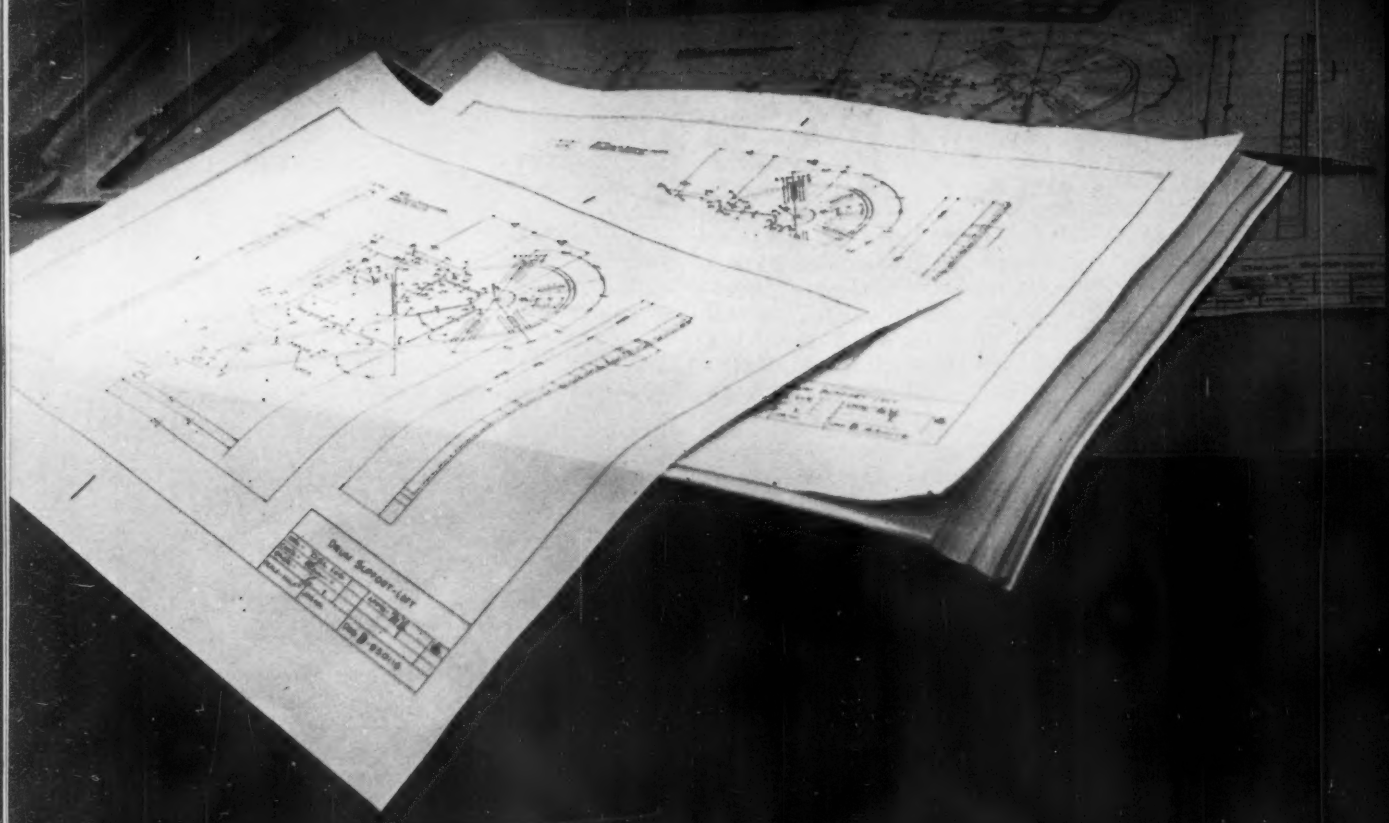

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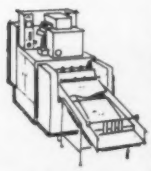

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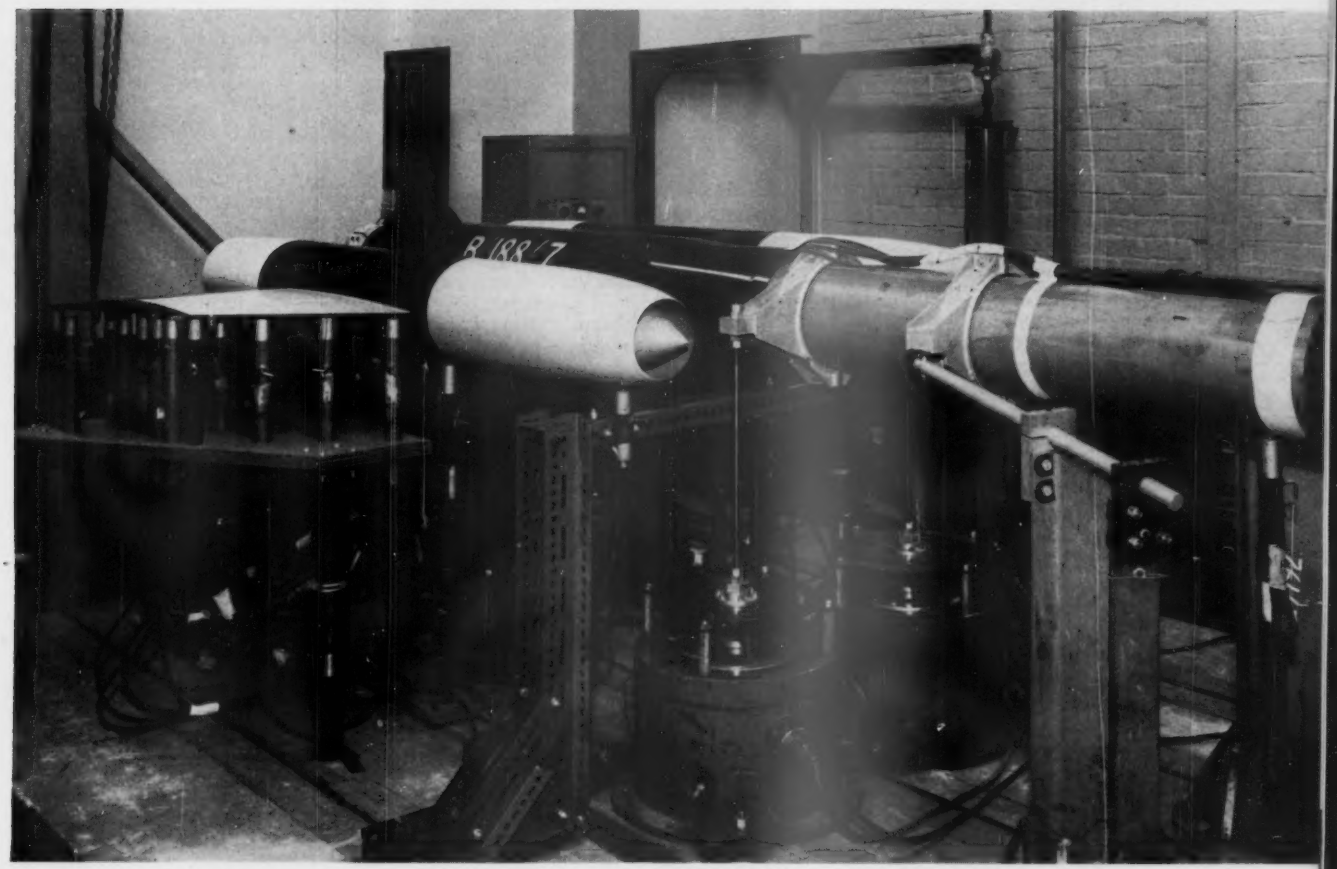


TECHNICIANS at Bristol have conducted a number of flutter tests on this model, which is shown on test rig in above photo.

Heat Poses T.188 Structural Problems

By Herbert J. Coleman

London—Use of stainless steel in construction of the Bristol Type 188 Mach 2 research airplane—vital because of a wide and varied temperature range in operating conditions—has posed design and construction problems for the British manufacturer.

Versatility has been built into the design, since the T.188 will perform flight research at speeds in excess of 1,500 mph. for periods long enough to study aerodynamic phenomena and kinetic heating. Bristol said that particular consideration was given in the design to research into propulsion developments.

The T.188 now is undergoing ground runup tests of its de Havilland Gyron Junior DGJ 10 turbojet engines, which produce 10,000 lb. thrust each. This engine is fitted with afterburner which operates at a combustion temperature of 2,000K (3,140F) and produces a thrust increase of 40%, to 14,000 lb. total thrust. The airplane will make its first flight soon.

Decision to use stainless steel for the wing and fuselage introduced design and development problems, some of which have been outlined by D. I. Vickery, Bristol assistant chief engineer.

For instance, the wing is thin—4% chord in thickness—and of modified biconvex section; thus, the problem of retracting a conventional landing gear was acute. To attain the design objective, Bristol devised a main gear strut which occupies the full depth of the wing; wheels are retracted into the fuselage after rotation of their axles about the ends of the shock absorbers.

To provide effective roll power at supersonic and subsonic speeds, with an economy of control power, Bristol designed an aileron which combines all-moving tips and trailing edge flaps; Vickery noted that the structural problems in these elements are considerable.

All-moving tailplane is hinged to the top of the fin and operated by a power control within the fin. At the rear of the fin is a plain, slab rudder.

A significant target for the T.188 designers was solution of the problems of kinetic heating through development of materials used in the steel. This involved research, undertaken by Bristol and Firth-Vickers, into materials with these properties:

- **Highest possible elastic modulus.**
- **Highest possible strength** consistent with reasonable ductility and freedom from stress-corrosion.
- **Minimum disparity** between transverse and longitudinal properties.
- **Simple heat treatment to correct** effects of fabrication processes.
- **Reasonably large-size sheets** of high standard of flatness and surface finish, to closer thickness tolerances than is normal commercial practice.
- **Minimum possible drop in properties** at the operational temperatures.

Resultant tests produced two broad classes of steel from which the airframe is constructed. They are:

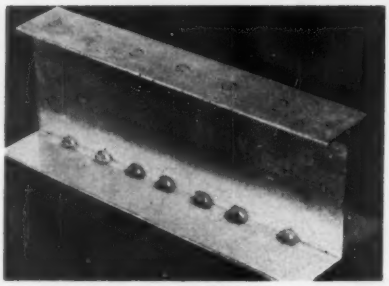
- **A 12% Cr (chrome) complex ferritic** steel in the 140,000 psi. u.t.s. (ultimate tensile stress) range.
- **A stabilized austenitic 18/8 Cr/Ni**

(chrome-nickel) steel at about 128,000 psi. u.t.s.

Explaining this choice, Vickery noted that, for practical purposes, cruising flight at Mach 2 in the stratosphere implies steady (or soaked) skin temperatures of about 100C (212F); yet Mach 3 corresponds to about 280C (536F). During preliminary assessment of materials, technicians plotted strength and stiffness for this range of temperatures of various aluminum alloys, titanium alloys and steels.

Investigation showed, Vickery continued, that aluminum alloys are "unacceptably weak at around 180C (356F)" while the decline in tensile strength of stainless steels was comparatively small. However, specific strength of pure beryllium and titanium alloys was better than the quoted steels. Aluminum alloys also suffered a serious decrease at about 200C (392F) in tests for specific stiffness, while the stainless steels were "clearly superior" to both aluminum and titanium alloys.

These tests convinced Bristol that development of stainless steel could lead to structures potentially suitable for higher temperatures, but there would be a long delay in delivery. However, a form of the 12% Cr steel was being used in heat-resistant applications in turbojet engines, and the austenitic steels were in production for lower



CLOSEUP shows puddle-welding joints which company says results in high strength-weight ratio.

strength applications, primarily for commercial uses. They also were being used in wide tolerance specifications, which interested Bristol because of the steel's greater formability in double-curvature applications.

Although the 12% Cr steel met the original design aims, Bristol had "great difficulty" in obtaining large enough sheets which were flat in the high heat-treated condition; stretch flattening was impossible. Later, an acceptable product was devised by "block-tempering" and hammer-flattening followed by milling, taper-milling and taper-grinding to close tolerances.

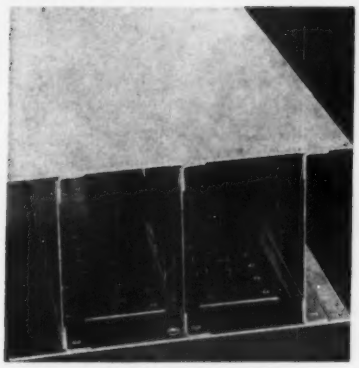
For the austenitic steel, the elastic modulus of 25 x 10^6 was substantially lower than that of the 12% Cr steel (31×10^6) but this was improved by a final heat treatment. At Firth-Vickers, technicians worked out production by a continuous strip-rolling process.

Use of these steels prescribed similar techniques in design of bolts, forgings and fastenings. Although rivets made of 12% Cr steel worked out in tempered condition of 140,000 psi. could be set by squeeze or percussion tools, these methods were incompatible with limited access in many parts of the fuselage or on thin sheets. Blind fastenings and patent rivets were developed to solve this problem.

A welding technique was developed to overcome the difficulties of mechanical fastenings. Called "puddle-welding," this method is achieved by local controlled fusion of the sheets of material beneath the arc automatically struck from an electrode within an argon gas shield.

This system now is used for major jointing throughout the T.188 structure and can produce automatic welds between materials from 0.3 in. thick to 0.012 in. thick. Welds also can be made within structures no more than ½ in. deep. Bristol says the method is versatile but skill is required in both design and production to avoid accumulation of minute shrinkages or distortions.

Other design problems arose because



SMALL Jo-Bolt fasteners are used extensively in fuselage construction.

of stresses induced by temperature gradients in the structure during the heating and cooling phases; every heating cycle results in one stress cycle. Thermal stresses also can affect ability of the T.188 to react to flight loads. Vickery pointed out:

"In general, the temperature differences exist for greater times than the buildup of load in a gust or maneuver, so that stresses resulting from an acceleration to high Mach numbers will exist when the steady speed is reached, when "g" could be pulled. In the locality of large heat sinks, the thermal stresses can exist for many minutes."

Vickery added that thermal stresses are "likely to have more effect on ultimate strength when they are compressive than when they are tensile."

In the thermal investigation, the Bristol design team studied these factors:

• **Restraint on fuselage expansion** produced by bulkheads, a condition arising because bulkheads do not heat as quickly as the outer shell. This can be severe in case of fuel tank bulkheads kept cool by fuel contact. Most severe stresses are bending stresses induced in fuselage stringers; resultant bowing of stringers has an adverse effect on compression strength of the skin-stringer combination. To alleviate this, Bristol uses a light alloy where the bulkhead remains cool; stringer joints at the fuel tank ends have been made by a single pin to provide minimum axial bending stiffness along the shell.

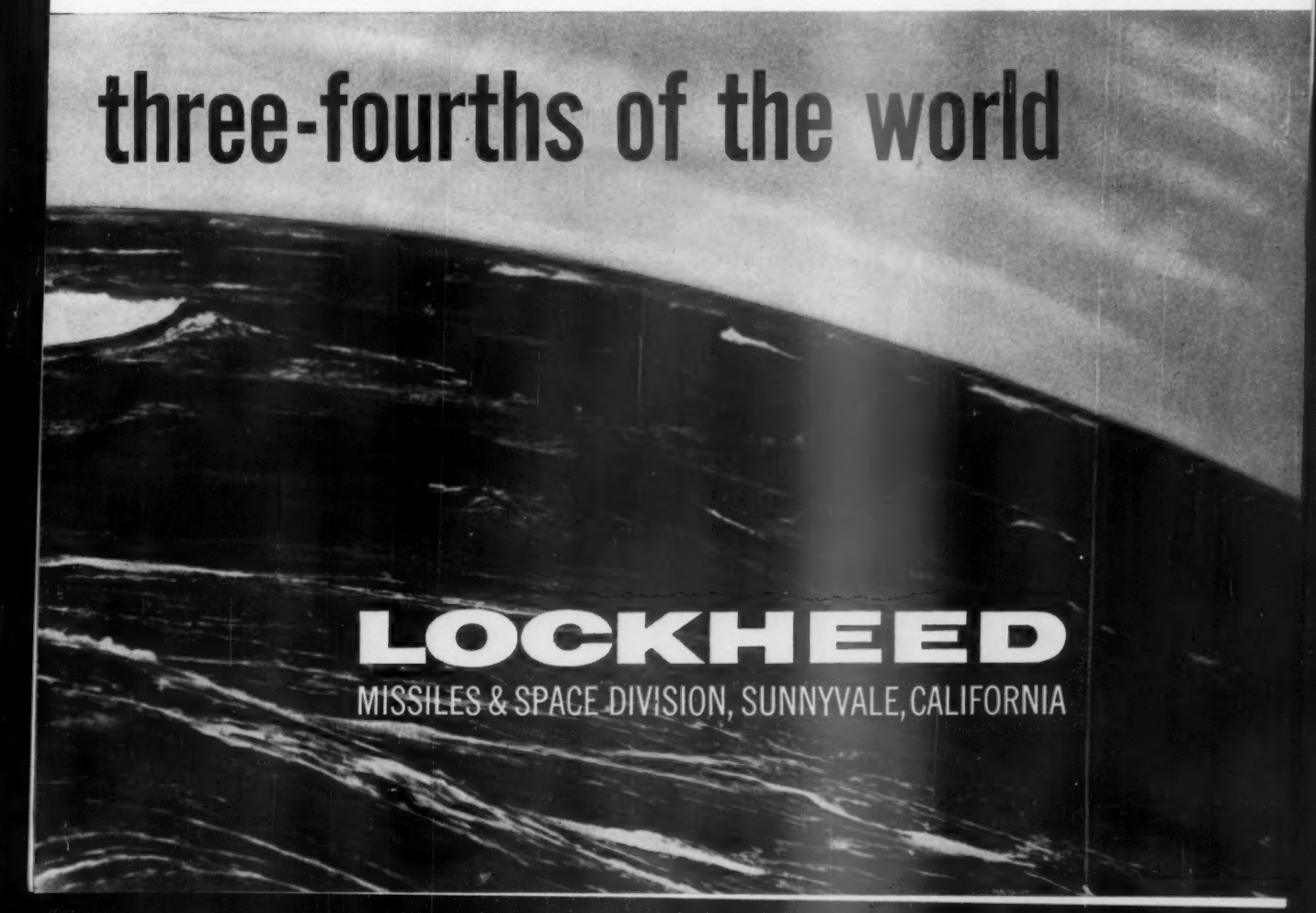
• **Spanwise restraint by spar web** of wing and tailplane skin expansion, a problem minimized by keeping restraint of spar webs as small as possible. Intermediate webs are corrugated vertically to reduce spanwise end load stiffness. Thinness of the wing helps here in keeping temperature differences down, as does the absence of any large heat sink, i.e., the presence of fuel.

• **Temperature gradients exist in the** fuselage due to large heat sinks provided by the fuel, and a complex pattern of shears and end loads is set up in the fuselage skins. Vickery said calculations can only give approximate information on the stresses which are induced.

THIS MODEL was used to measure flutter on tail section at low speeds.

• **Transparent materials used in cockpit** layout are particularly sensitive to thermal stresses; these have to be some form of glass because of high temperatures. In addition, if "g" forces are applied at deceleration to slow the airplane down, resulting aerodynamic loads can give tension stresses, thus increasing the complications. Bristol now is using a transparent material with a low coefficient of expansion to reduce magnitude of thermal stresses to an acceptable point; use of soda lime glass was found to put unacceptable limits on T.188 performance.

Bristol has made extensive use of the fuselage-contained fuel supply as a heat



Monsanto

Space-Age Project "SUPER THRUST"

A CHEMICAL EXPEDITION..

...exploring hydrocarbons for High-Mach fuels... seeking new paths to heat stability

Monsanto research is making significant strides forward in the search for heat-stable hydrocarbon fuels for the next generation of jet engines. Working under contract with the propulsion laboratory, Wright Air Development Division, Monsanto chemists are blocking out a variety of hydrocarbon compounds for fuels "task-tailored" to engine design requirements. These fuels promise to meet the three most pressing fuel requirements:

High thermal stability
High energy per unit of weight and volume
Optimum heat-transfer capability

To meet stringent fuel requirements as they become more closely defined for advanced jet engines, Monsanto has screened some 6,000 chemical compounds. More than fifty hydrocarbons have been selected for intensive evaluation based on their promising physical properties.

From the exhaustive search and confirming experimentation, Monsanto research has determined that a hydrocarbon fuel is within reasonable reach that will not decompose or "gum" in the 600°-800° F. range. Its high heat stability will enable it to serve as the heat sink . . . essential in advanced-design jets to relieve the lubricant, engine components, thrust chamber and "skin" from heat stresses.

IMPROVED DUAL-PURPOSE FUEL: ENERGY AND HEAT SINK, HEAT STABLE, SUPER THRUST

From current study, it appears that the compound with optimum jet fuel properties may turn out to be either a relatively simple mixture of highly "pure" cyclic, saturated chemicals or narrowly selected fractions of refinery streams, hydrogenated to saturation and carefully separated. This necessarily would be a chemically made fuel, not a run-of-refinery mixture. As such, it would provide more closely defined physical and chemical properties for predictably uniform performance.

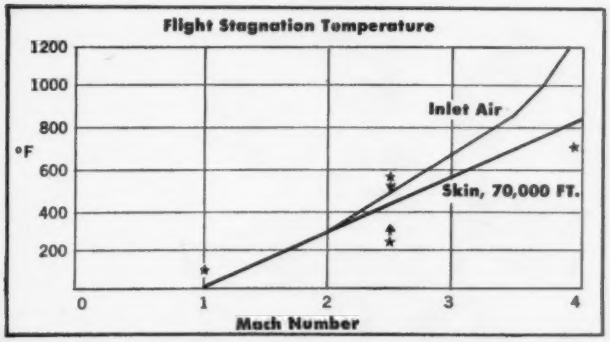
Its requirement parameters are becoming fairly clear: BTU's per pound—18,500 to 19,000 minimum; specific gravity—0.85 to 0.95 (or heavier); no coking or "gumming" to 800° F. In addition to heat stability, next-generation jet fuels must have maximum heat of combustion (on a weight-and-volume basis) to increase the jet craft range.

Monsanto is in an unusually sound position to help engine makers and the military in solving the fuel problem. Its Special Projects Laboratories are staffed and oriented for precisely this type of research. In addition, Monsanto's Organic Chemicals Division has a basic position in aromatic compounds. Through its Lion Oil Division, Monsanto has a basic supplier position in refinery products (and the research facilities) to study the possibilities in paraffins, naphthenes and close cuts of refinery streams.

Several candidate fuels have already been prepared and manufactured in evaluation quantities; for example, isopropylbicyclohexyl. Study is continuing in many other areas, including both naphthenes and paraffins. Most important, with a variety of "candidates" Monsanto next needs to know specifications based on design: the density limits, exact heat stresses, minimum thrust limit. With these parameters "jelled," Monsanto can guide the engine maker to a variety of candidate cyclic or paraffinic hydrocarbons for evaluation.

ENDOTHERMIC-REACTION FUELS— ANOTHER AVENUE TO "SUPER THRUST"

Chemically, there is little chance that a saturated hydrocarbon fuel stable above 900° F. will be found.



At subsonic speeds, engine heat can be dissipated by convection to the air. At speeds higher than Mach 1.4, the rate of air cooling reaches borderline; at High-Mach speeds, air cooling is inadequate. The frictional heat of aerodynamic drag and the reject heat of engine combustion must be dissipated to some part of the vehicle or its load. Conventional liquid JP-4 fuel, a refinery stream hydrocarbon cut, reaches its borderline limits of heat stability near speeds of Mach 2.5. Fuels having higher limits of heat stability are required.

Approximate cooling requirements:

Mach Number	HEAT SINK, BTU/lb. of Fuel Required	Available JP-4 †
1.0	★ 130	170
2.5	★ 220-550	170
4.0	★ 725	170

† Conventional liquid jet fuel heated from 100-400° F

(*Please turn page*)

However, a fuel system may be developed—with compounds capable of undergoing endothermic reactions—that will operate in environments in the 1200-1900° F. temperature range. Basically, this requires the development of a compound to be converted *in flight* to the actual fuel, in a "package" chemical converter that would utilize part of both the reject heat of fuel burning and the friction heat of aerodynamic drag. Endothermic fuels show promise of increasing vehicle range through greater fuel efficiency, since heat energy normally lost is absorbed during the endothermic conversion and released during combustion. A few of the promising possibilities programmed for experimentation:

THERMAL CRACKING OF HYDROCARBONS:

Cracking:

$$C_8H_{18} \longrightarrow C_4H_8 + C_4H_{10}$$

Heat Absorbed: 370 BTU/lb.

DEPOLYMERIZATION TO OLEFINS:

Diisobutylene

$$CH_2{=}C(CH_3)CH_2C(CH_3)_3 \longrightarrow 2(CH_3)_2C{=}CH_2$$

Heat Absorbed: 390 BTU/lb.

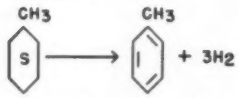
RETRODIENE SCISSION:

Monomerization of dicyclopentadiene

Heat Absorbed: 310 BTU/lb.

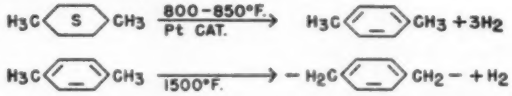
DEHYDROGENATION AND AROMATIZATION:

Dehydrogenation of 6-membered naphthene to an aromatic



Heat Absorbed: 900 BTU/lb.

STABILIZED HIGH-TEMPERATURE FREE RADICALS (Series Reaction):



Total Heat Absorption (sensible heat plus heat of reaction): 3980 BTU/lb.

Monsanto research has blocked out several more "types" of endothermic reaction, each with dozens of specific compositions, as promising starting points for heat-sink fuels to power supersonic craft.

CHEMICAL FUELS—ANOTHER CHEMICAL CAPABILITY OF MONSANTO

Where design and fuel performance are interdependent, you are invited to enlist Monsanto's capability on the chemistry of the fuel. Write or call: MONSANTO CHEMICAL COMPANY, Department AV-5, C Building, St. Louis 66, Missouri.

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* Radiation-Resistant Heat-Transfer Fluids
* High-Temperature Lubricants and Additives
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* Pure Silicon for Transistors, Rectifiers, Diodes
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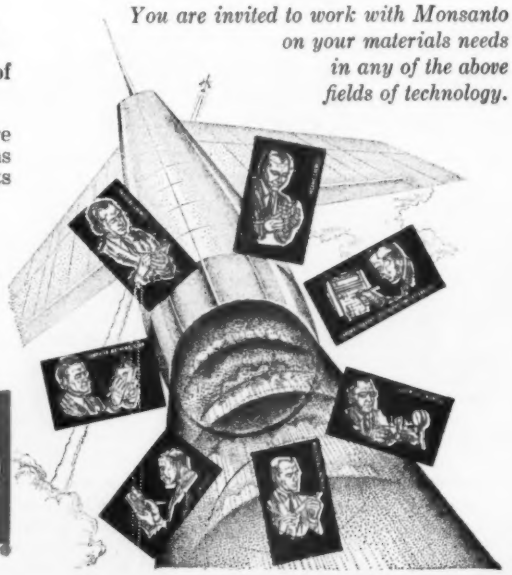
* Materials for Vibration Damping
* Heat-Resistant Resins for Laminating and Bonding
* Inorganic Polymers
* High-Energy Solid Propellants

You are invited to work with Monsanto on your materials needs in any of the above fields of technology.



Monsanto

sink. For example, the fuel is precooled before entering the tanks and fuel then is used to cool hydraulic oil, gearbox oil, electrical devices and considerable instrumentation.

Temperature considerations are reflected in design of the fuel system, keeping in mind the large range of flow rates and wide range of altitudes under which it must function. Seam-welded tank body structure was impractical, so Bristol investigated schemes for nonmetallic sealants in conjunction with materials, welding and jointing. A number of joint tests were made under load and representative tanks were "flown" through varied flight cycles of heat and cold, pressure and fuel drainage. T.188 design was well advanced before a fillet sealing treatment involving successive coats of different sealants was shown to have promise.

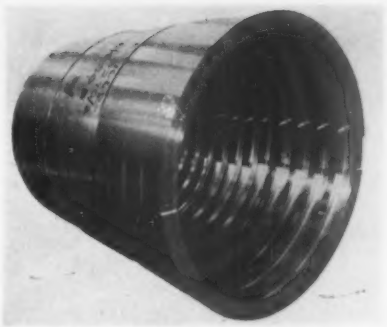
Interchangeable Intakes

One of the major design aims of the T.188 was a requirement that engine air intakes be interchangeable, posing a problem of mounting the engines on the wing. Vickery said a number of positions were considered; underslung pods raised the airplane too high off the ground and raising the nacelles resulted in a cranked wing structure of low structural efficiency, poor torsional stiffness and complexity in construction.

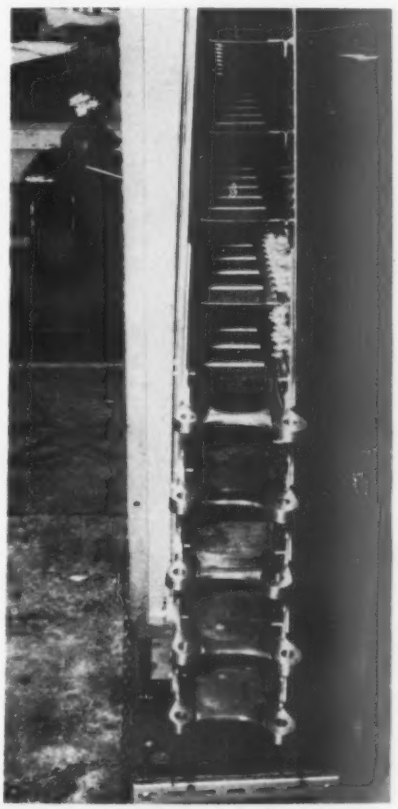
The team decided finally to place the engine in a centrally-mounted nacelle in which the multiple wing spars were encastered (built in at the supports) in the diametrically opposite sides of a series of structural ring frames. Shell of the nacelle thus could be part of the torque-resisting wing structure and superior bending stiffness of the ring frames could be utilized.

This construction problem—building a ring-stiffened cylinder some 4 ft. in diameter—resulted in design of large centrifugally-spun cast steel barrels which were machined out to provide integral ring frames with attachment pockets for two-pin lug attachment of inner and outer wing panels. Shortly after, Firth-Vickers tested forged rings of comparable size and this design is in current use. Shell and I-beam webs are machined to less than $\frac{1}{16}$-in. thickness at the thinnest point to give a weight per barrel of less than 270 lb. Cost per pound also is less than sheet-metal fabricated components.

Bristol had difficulty in structural design of the engine intake, because high pressures developed forward of the engine and could not be prevented from leaking forward between the outside skin of the intake and the duct wall, on which Vickery said they exert inward pressures of "several atmospheres." Puddle welding is used extensively to provide a light structure strong enough to react to the loads.



CLOSEUP of T.188 nacelle barrel shows detail of inner rings which were developed by Firth-Vickers.



T.188 wing section is shown on jig at Filton production plant. Note ultra high tensile strength end fittings in place at bottom.

In design of the wing box, peak running load at the body side is about 30,000 lb./in. and several spars are used to stabilize compression skin. Ring is provided in the nacelle barrel to line up with each spar; end load in the wing skin has to be collected into a number of lugs. These enter into pockets in the outside of the barrel and are attached to barrel rings by bolts which run chordwise. Lug size was a critical factor and to keep the widths small, Bristol decided to use an ultra high tensile steel (u.h.t.s.) of 220,000-240,000 psi. ultimate strength. Steel in this strength range had to be nonstainless, so each spar and its associated skin was bolted to a u.h.t.s. forging out of which were "grown" the lugs to attach to the nacelle barrel.

Similar form of connection was used for both the outer and inner wing boxes, although designers met further complication in the sweepback of the outer box. The u.h.t.s. forgings are zinc plated, and bolt materials are in same strength range as the lug forgings.

Tailplane, which is subject to high rolling moments in yawed flight, has peak end running load at the root on the order of 10,000 lb./in. Rolling moments are reacted by a pair of point loads at the hinges.

Vickery noted that diffusion of these point loads into a wide shallow box was difficult, in that many attachments in the hinge area had to be blind. Solution included use of a pair of steel ribs machined from forgings. These ribs extended for the entire chord of the tailplane box, to minimize any shear lag effects; this made the cross section as nearly as possible effective in torsion to give required stiffness. Maximum depth on the tailplane does not much exceed 3 in., so there could be no ribs in the spar box between the root and tip.

Aileron Structure

Aileron structure is two multicell boxes; trailing edge portion is a box running spanwise and the horn section is a box running chordwise. To handle stiffness and load requirements at the junction of the two boxes, heavy skins and machined ribs are used in this region. Boxes are so thin that the ribs can be fitted only at the ends. The boxes are broken at the aileron hinges to permit fitting of the machined ribs and are finally joined by blind attachments with rib flanges acting as butt straps.

Due to area ruling of the fuselage, double curvature skin panels were needed and this necessitated use of the cold-worked austenitic sheet of lower strength and stiffness than the wing skins. Weight penalty from this, Bristol says, is offset against benefits of the area ruled shape.

Installation of the hydraulically-powered flight controls was difficult due to space available in the wing, fin and aft fuselage. This factor, and large flow requirements at high pressures, led to development of a range of rigid pipe joints, swivel joints and flexible pipes. Landing gear and speed brakes also are hydraulically powered.

Fluid temperature is reduced by rejecting heat to the fuel. However, since many portions of the hydraulic system remain idle, or move at low rates when the airplane is hot, Bristol experienced some difficulty in finding a fluid with acceptable high temperature properties. These demanded chemical stability,

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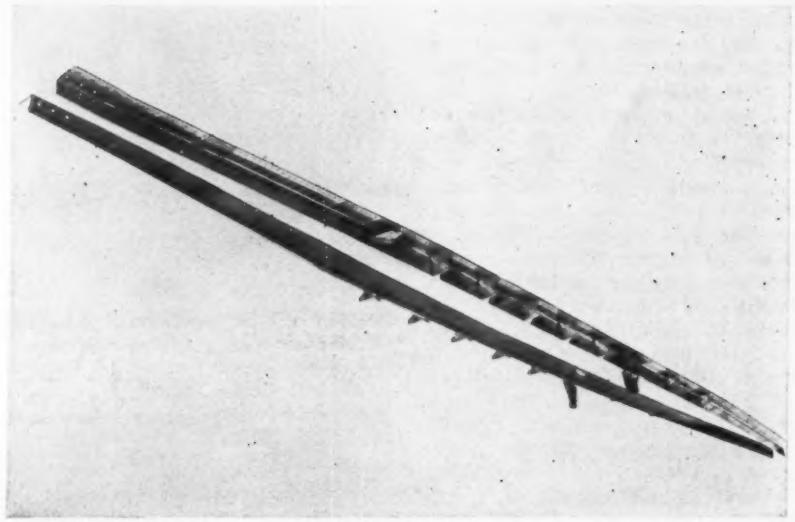


BRISTOL Type 188 longerons are constructed in a single section.

small viscosity range and high bulk modulus.

Temperatures again were a prime factor in selection of electrical system components, such as cables, fuses, solenoids and plugs.

Air conditioning system is an air cycle unit of the regenerative type using engine bleed air as a source of supply. Cockpit discharge air is the cooling medium for the primary cooler, the bleed air passing through this unit before going through a water boiler and the turbine of the cold air unit into the cockpit. Water boiler, Bristol said, is essential at high altitudes when air mass flow through the system is at a minimum.

Air passing through the cold air unit can be at temperatures around 400C (750F) and this induces a cooling problem for bearings and oil in that unit. To overcome this, a small amount of turbine-cooled air is bled through the cold air unit shaft into the bearing housing to maintain an acceptable temperature.

Air in the pilot's ventilated suit is supplied directly from the cockpit incoming air supply. In case of system failure, cold air supply is directed from a compressed air bottle for protection.

FAA Plans $12 Million Supersonic Studies

Washington—Federal Aviation Agency plans to use the $12 million requested to launch a supersonic transport program for studies by two engine manufacturers and a study by three airframe manufacturers if the companies agree to invest their own capital in the project.

Federal Aviation Agency Administrator N. E. Halaby told a House Appropriations Subcommittee that as a result of these studies, the U. S. could decide within 18 to 24 months whether and how to continue the project.

Specifically, Halaby said: ". . . the government could agree to put up some of the development money, the manufacturer would agree to put up some more, and the purchaser of these 200 airplanes—which might cost $12.5 million apiece . . . would agree to reimburse development costs in the purchase price."

PRODUCTION BRIEFING

Garrett Corp.'s AiResearch Mfg. Co., Los Angeles will develop a turbogenerator for one-shot missile applications under contract from the Army Ordnance Corps. The 3-lb. turbogenerator, powered by solid propellant, will supply 150 watts of a.c. and d.c. power for 100-sec. duration.

Sperry Utah Co., Division of Sperry Rand Corp., Salt Lake City, Utah will continue production of Sergeant missile spare parts under Army contracts totaling $11.5 million. The solid-propellant Sergeant, scheduled to replace the liquid-fueled Corporal missile, is in production at the division.

Avco Corp.'s Lycoming Division has signed an agreement with Piaggio & C., Genoa, covering the manufacture of Lycoming T53 and T55 gas turbine engines in Europe.

Northrop Corp.'s Norair Division, Hawthorne, Calif., will install a TRIGA Mark-F research reactor to study effects of space radiation environments. Reactor will be supplied by General Dynamics' General Atomic Division.

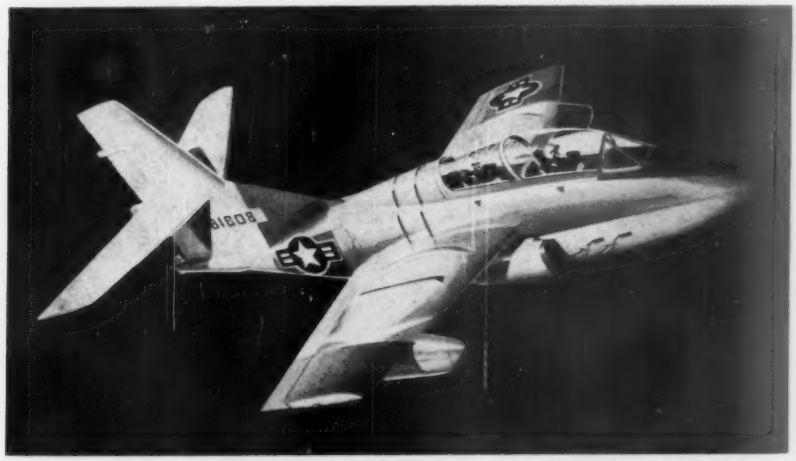
United Control Corp., Bellevue, Wash., will supply, under $450,000 contract from Boeing, electrical-mechanical equipment for controlling temperature of coolant flow to Minuteman ICBM guidance and control section while missile is on "alert" in silo.

Nihon-Lockheed Monorail Co., Ltd., newly formed monorail enterprise with an authorized capital investment of $2.2 million, will be engaged in the manufacture of Lockheed-designed supported-type monorail systems. New firm was formed by Lockheed and seven Japanese companies. First monorail system will be installed at Nikko, Japan, next year.

Nike Zeus anti-missile system target radar had its first tracking test May 27 at Ascension Island, tracking an Atlas missile fired from Cape Canaveral.

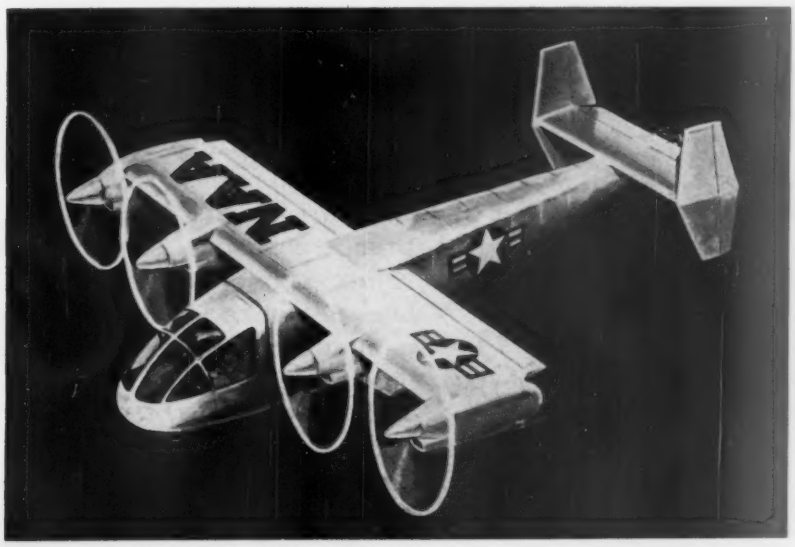
General Electric Missile and Space Vehicle Department has a $13-million Air Force contract for servicing and installing equipment for Mark 3 and Mark 4 nose cones at nine Atlas ICBM bases. Work began last year under letter contract and is to extend through 1962.

Atlantic Research Corp. has a contract for $248,000 to produce 12 Iris rockets for use in NASA's upper atmosphere research program.



North American Proposes Two V/STOL Concepts

Vertical takeoff and landing testbed based on the North American T2J-1 Buckeye is proposed by North American Aviation Columbus Division to flight-test General Electric's J85 lift-fan VTOL concept (AW May 15, p. 26). It would have louvered fans in wings. Wing pods would house main landing gear. North American plans to build the tilt-wing VTOL transport below with its own funds to gain flight experience. The tilt-wing transport would have a gross weight of 5,200 lb. and payload capacity of 1,000 lb. (cargo or five passengers). Engines would be four Allison T63 turboprops (250 eshp.) for speed range from hover to 250 kt. Tilt-wing aircraft is similar aerodynamically to NAA's four-ton-payload tilt-wing tri-service VTOL transport proposal (AW May 1, p. 32).



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The Spectrosun® beam closely approximates the sun's radiation in intensity, uniformity, spectral match, and collimation. Combined with your other environmental test equipment, the Spectrosun can help evaluate temperature equilibrium, material deterioration, and solar energy conversion.

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Beam Diameter: 3" to 20'
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Spectral Match: 2000 to 30,000 Angstroms
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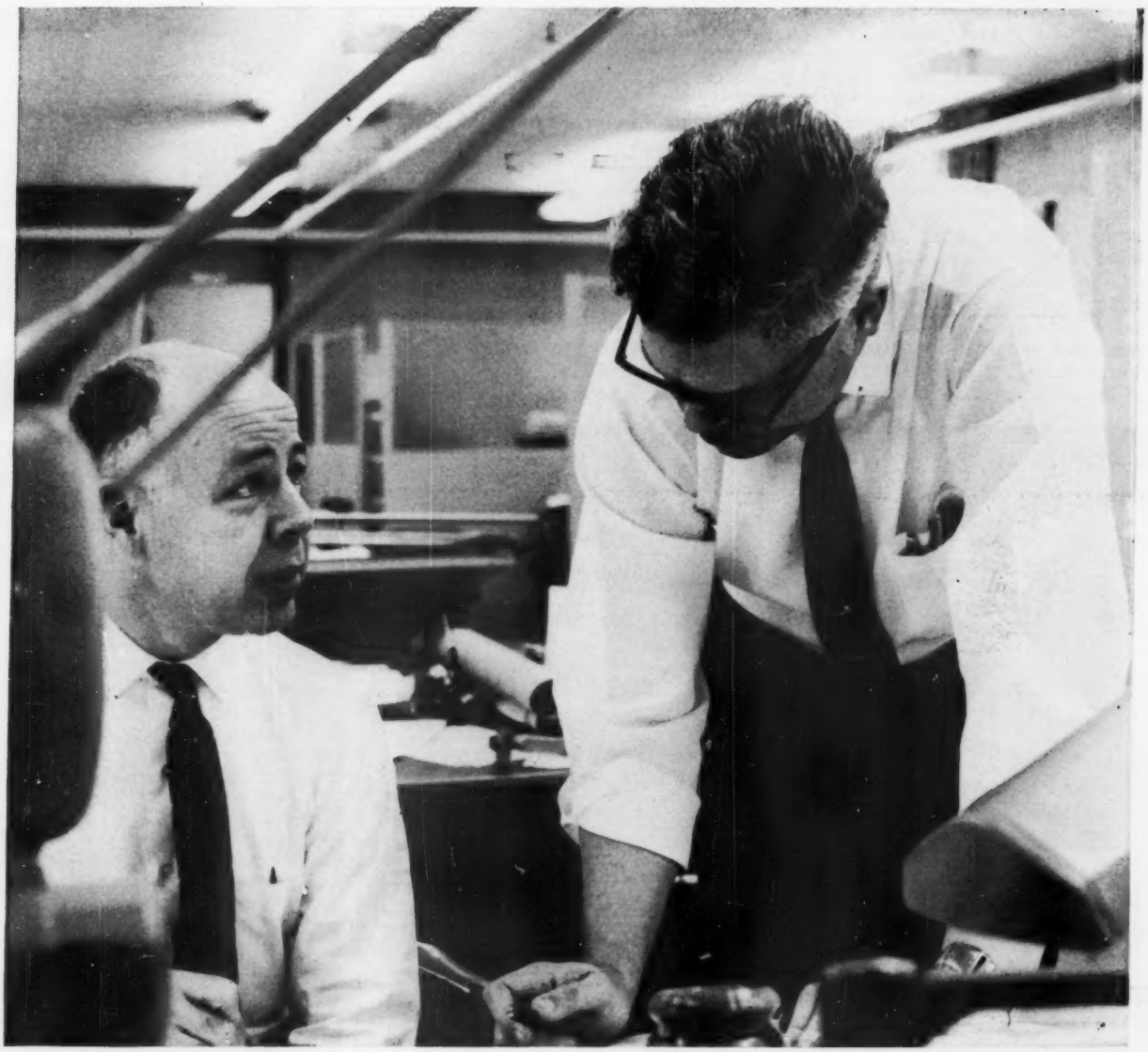

these are men you should know . . . Delavan fuel injection specialists

CREATIVE DESIGN IS THEIR RESPONSIBILITY

Doing something better than it's ever been done before is the essence of successful, creative design. These Delavan men . . . Don Sill, Project Engineer, and Jim Brucker, Senior Project Engineer . . . approach each problem with this goal in mind. The result of their work on afterburner and main engine fuel injectors is reflected in Delavan's acceptance among leading engine manufacturers. From the early beginnings of gas turbine engines, Delavan has been designing and producing fuel nozzles. Proof of this specialized ability is that Delavan has produced more than a million fuel nozzle injectors, and is specified on 11 engines currently in production. This proven ability to design and manufacture uniform, high performance nozzles is important to you.

get to know these Delavan fuel injection specialists

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BREGUET 941 with flaps in STOL configuration deflects propeller slipstream downward, inducing lift.

Breguet Developing STOL Transport

By Robert E. Farrell

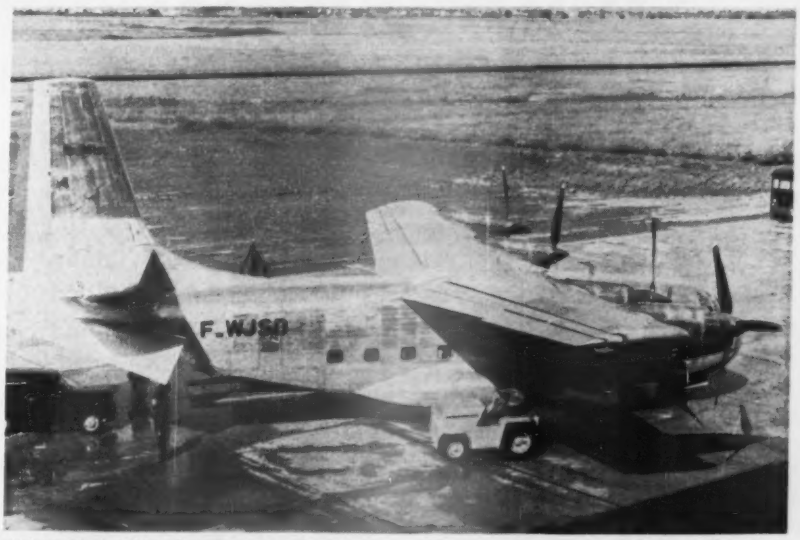
Paris—First flight earlier this month of Breguet's 941 transport marks the culmination of the French company's 13-year STOL effort based on the deflected slipstream—or blown wing—principle.

The four-engine 941 (AW May 15, p. 38), powered by Turbomeca Turmo 111D free turbines delivering 1,250 shp. each, will lift off a grass strip within 770 ft. at its gross weight of 20 tons. The unpressurized aircraft is designed for military and civil markets. A single prototype was financed by the French government with the understanding that follow-on production orders might be forthcoming if the project tests out successfully.

Breguet is also planning a 50-passenger pressurized version of its 941 STOL transport—designated the 942. Prototype of this version is expected to fly next year. Deliveries on the 942, presently priced at $800,000, are scheduled to begin in 1964. No firm orders have been placed for either the 941 or 942. Breguet officials, however, say considerable military and commercial interest surrounds both aircraft.

Breguet's STOL efforts, begun in 1948, have consistently centered on the deflected slipstream principle. A highly developed system of slats and slotted flaps deflects propeller slipstream downward, thus inducing lift. The aircraft's four 14.75-ft.-dia. propellers "blow" over the entire wing surface. Changeover from deflected slipstream lift to normal aerodynamic lift is progressive. Breguet says the aircraft's low forward

BREGUET 941 is powered by four 1,250 shp. Turbomeca Turmo turbine engines.



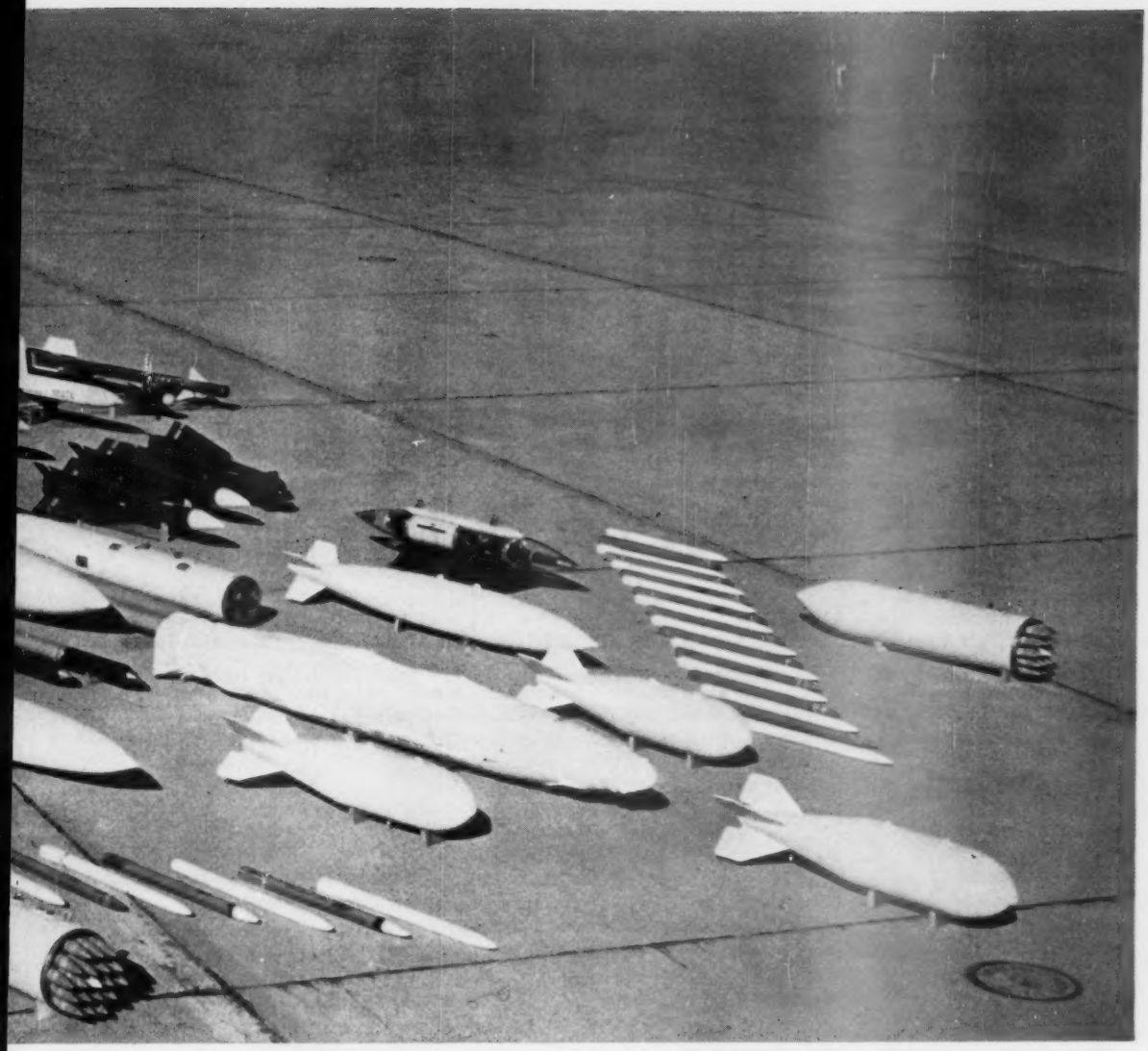
WING TRAILING EDGE houses double flaps. The second flap acts only as a flap in its inboard section and as flap and aileron in its outboard section.

LIGHTWEIGHT FIGHTER WITH

Here is the Northrop N-156...a bold new concept in fighter weapon systems

The twin-jet supersonic Northrop N-156 is more than an aircraft; it is a complete family of lightweight fighter weapon systems designed to fulfill the many air support roles of limited war: close support of ground forces, reconnaissance and surveillance, interdiction, air defense and air superiority. The N-156 can be deployed from the United States zone of interior to any point in the world within 24 to 48 hours. It can then be dispersed throughout the theater of operations, utilize advance bases with short, unimproved runways, and operate with minimum logistic support, fast turnaround and extremely low maintenance downtime.

Its high performance, extreme maneuverability and ease of handling have won the Northrop N-156 unanimous acclaim as a "pilot's airplane." An exceptionally safe and reliable aircraft with unusual aerodynamic stability, it can accomplish its mission, return and land safely with one engine out. Very low fuel consumption eases the storage and resupply problems likely to plague advance areas. Maintenance and service can be easily accomplished from ground level without



A HEAVYWEIGHT PUNCH

designed specifically for limited warfare...ready now.

crew stands. In short, from both a tactical and logistic point of view, the N-156 is ideally suited to the mission requirements and problems of limited warfare.

The economics of the Northrop N-156 are also highly favorable for limited warfare. Low initial cost plus exceptionally low operating and maintenance costs make it possible to greatly increase the number of units in the field for the same budget dollar. Simplicity of maintenance also reduces the number of trained personnel, the amount and complexity of ground support equipment needed in the field. The result is an extremely flexible force, able to respond effectively to pressures anywhere in the world in the shortest possible time, and with minimum dependence on the difficult supply posture likely to prevail in remote areas.

The Northrop N-156 has been flying since July 1959. It is a developed weapon system, ready for immediate production. Deliveries can commence in just 14 months.

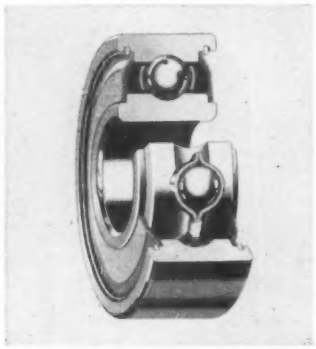
NORTHROP

NORTHROP CORPORATION, BEVERLY HILLS, CALIFORNIA

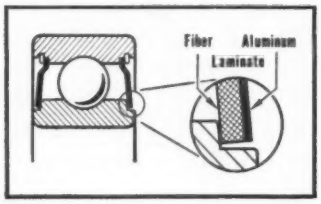
A NEW PRODUCT DEVELOPMENT FROM BARDEN

TO KEEP YOUR BRAINCHILD SPANKING CLEAN

A spaceman's helmet can keep a boy's face clean for a while, but the protection is far from permanent. A new Barden development, however—Flexeal—positively seals precision bearings against dirt while retaining needed lubricant, thus greatly increasing the reliability of high-speed motors, generators, computer memory drums and other equipment.



Sectional views of Flexeal precision bearing show how fiber-aluminum laminate seals against ground surface of inner ring to effectively block out dirt and retain bearing lubricant.



SEALED PRECISION BEARINGS

Barden's new Flexeal meets the demand for a low-friction seal that can stand up at high speeds in contaminated environments. Flexeal bearings are precision bearings with a seal of fiber-aluminum laminate that fits smoothly against a ground surface on the inner ring. The design effectively seals in lubricant, seals out contaminants and prevents airflow through the bearing. Friction is negligible and the bearing may be run up to the life limit imposed by the lubricant.

TEST RESULTS

Barden Flexeal bearings have been operated up to 3,000 hours at 80,000 rpm in portable grinders. Flexeal stands up under lineal speeds of 6,000 feet per minute, as against 2,000 to 3,000 fpm limits of most other rubbing seals. Operating temperatures range up to 300°F.

AVAILABLE NOW

Flexeal bearings are now available in ten unflanged and four flanged sizes from .3125" to 1.8504" O.D. For further data, ask for Flexeal Data Sheet F-1.

Barden is a major producer of precision ball bearings for instruments, weapon systems, computers and other high quality equipment.

for reliability...specify

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Western Office: 3850 Wilshire Blvd., Los Angeles 5, Calif. DUnkirk 5-0034

speed substantially raises lift by adding to the propeller slipstream, thus permitting the 941's high payload characteristic.

Basic safety feature of Breguet's STOL system is provided by the manner in which the aircraft's four power units are mechanically interconnected. Four propellers are operated off a common shaft. If a propeller has to be feathered it is disconnected from the system and the three remaining props are powered by the four engines.

Correspondingly, failure of one engine does not mean failure of its propeller. The three remaining engines continue to assure symmetrical operation of the four propellers. Breguet engineers estimate that failure of one engine means a loss of thrust of only 17%, compared with a drop in thrust of some 25% in conventional four-engine power systems.

Safety factors were also designed into the flap system since failure here would destroy STOL performance. Thus symmetrical flap extension is assured by means of a mechanical linkage composed of a torsion shaft which deflects abnormal or unsymmetrical loads. Flaps are operated simultaneously by two independent hydraulic circuits, either one being capable of operating the flap arrangement.

Breguet engineers also claim the 941's power-on landings constitute a safety factor. To get highest STOL values in landing, the 941 is normally brought in with four engines set at more than 60% of maximum power. But to permit a steep descent angle of about 60 deg., the pitch of the two outboard propellers is set at zero, thus inducing drag by achieving an artificial reduction in aspect ratio. Speed in this configuration is somewhere around 45 kt. Immediately on touchdown all four propellers are thrown into reverse.

This power-on landing procedure obviously helps a pilot who decides he wants to abort and try again. Without changing power setting of the engines, he merely brings the two outboard propellers into play via pitch control. Lift response is immediate, Breguet says.

The 941 uses conventional flight control systems with exception that aileron control under full STOL configuration —when entire trailing edge of wing is deflected up to 90%—is ineffective. The company therefore developed a system which links pitch control of the two outboard propellers with the pilot's control yoke. Under STOL conditions, when the pilot banks the aircraft he automatically increases prop pitch on the outside of the turn and decreases prop pitch on the inside of the turn. This sort of differential thrust enables the aircraft to carry out tight coordinated turns at low altitudes under complete STOL conditions.

Breguet 941-942

	941*	942
Span	76.1 ft.	76.1 ft.
Length	76.1 ft.	76.8 ft.
Height	30.7 ft.	31.7 ft.
Wing area	887 sq. ft.	887 sq. ft.
Empty weight	25,170 lb.	26,950 lb.
Max. zero fuel wt.	39,600 lb.	39,600 lb.
Max. takeoff weight	45,000 lb.	45,000 lb.
Max. landing wt.	40,600 lb.	40,600 lb.
Max. payload	14,030 lb.	12,100 lb.
Cabin length	5.8 ft.	30.7 ft.
Cabin height	7.4 ft.	6.5 ft.
Cabin width	8 ft.	9.6 ft.
Cargo hold volume	2,100 cu. ft.	350 cu. ft.
Powerplant: four Turbomeca Turmo 111D free turbines of 1,250 shp. each; four three-bladed Breguet-Ratier props of 14.75 ft. dia.		
Landing gear track	11.8 ft.	10.5 ft.

* Pure cargo version

Breguet engineers feel the aircraft's lateral control is now perhaps too fine. Spoilers mounted atop wing, for example, were also linked to the differential thrust control system. It is probable the company will abandon use of these Breguet-designed spoilers.

Longitudinal control of the 941 initially was hampered by tailplane stalling under STOL conditions at high power. This stall tendency was washed out by making the tailplane adjustable and by fitting the leading edge with an inverted-camber fairing.

Most of these various flight control fixes—as well as the deflected slipstream system—have been thoroughly tested in Breguet's initial STOL flying testbed—the 940. This aircraft, grossing some 15,400 lb., first flew in May, 1958. Over the past three years the 940 has flown about 300 hr. At its gross weight of seven tons, the 940 clears a 15-meter obstacle within 625 ft.

The only difference between the 941 and 942 is the latter's circular fuselage designed for a differential pressure of about 3.5 psf. Wings of both aircraft consist basically of a box beam made of two web spars and one truss-web spar. Wing covering is honeycomb sandwich material. The wing contains four integral fuel tanks with total capacity of 1,940 gal. The leading edge contains a retractable slat; the trailing edge houses double flaps. The second flap acts only as a flap in its inboard section and as flap and aileron in its outboard section. Conventional servo-controls are provided on the elevators, rudder and ailerons.

Main gear consists of twin, tandem wheels attached to the same shock absorber. Shock absorbers also serve as ground jacks which permit adjustments of the aircraft's ground attitude. The main gear retracts completely into fairings on each side of the fuselage. The steerable twin-wheel nose gear retracts under the cockpit floor.

Breguet's 942 passenger STOL aircraft has a fairly flexible cabin arrangement. This permits high-density passenger configuration (11 rows of five seats) or a mixed passenger-cargo version. The latter configuration is laid out in eight rows of five seats plus a cargo hold 14 ft. in length located forward of the passenger compartment. The 942 has two passenger doors, aft and forward, both on the port side.

Cost of the 942 is broken down in the following manner: airframe, $540,000; propellers, $50,000; radio equipment, $30,000; engines, $170,000; transmission system, $10,000; total cost, $800,000. Using the normal ATA method, dollar cost per flight hour works out to $123.91 for the 942. This is based on 55-passenger loads and annual utilization of 3,000 hr.

Breguet officials feel their STOL aircraft, specifically the 942, is aimed at a market largely untapped up to now. This market, they claim, breaks down into two sections:

- **Short-haul air service** where road traffic doesn't exist and airport facilities are primitive, grass strip affairs. Africa presents the best example of this market.
- **Short-haul air service** in developed regions where air service is needed but is restricted due to insufficient landing facilities.

CAB Requesting Bids On Cargo Cost Study

Washington—Civil Aeronautics Board is soliciting bids for a complete study on air cargo costs designed to form the basis for future cargo rate making procedures.

"Air cargo has a great two-way potential—for tremendous expansion or for grave financial losses," CAB Chairman Alan S. Boyd told prospective bidders. "We need a hard core of basic economic fact to help us adopt the right policies."

Noting that the volume of potential air cargo is sensitive to rates, Boyd said a comprehensive analysis of cargo costs, to be completed by Nov. 1, would aid CAB in making decisions on these issues:

- **Basic relationship** between costs and rates.
- **Treatment of promotional** rates.
- **Methods of introducing** new rates.
- **Effect of new flight** equipment on rates.
- **Profitable rates needed** for volume shipments.

TRANSATLANTIC record-breaking USAF B-58 touches down at Le Bourget Airport, Paris, France, at the 24th International Air Show. The aircraft completed the flight from New York City in 3 hr. 19 min. 41 sec.

B-58 Record-Breaking Crew Members Hailed at

AFTER receiving congratulations from USAF Gen. Leon W. Johnson, above, crew's enthusiasm is shared by N. E. Firestone, general manager-GE's Flight Propulsion Div., Cincinnati, Ohio, Col. J. K. Johnson, Cdr. 43rd Bomb Wing, Carswell AFB, Tex., and J. T. Cosby, B-58 project manager, General Dynamics-Ft. Worth, top, right. Crew, bottom, right, Maj. Payne, Capt. Polhemus and Capt. Wagener examine the Charles A. Lindbergh plaque at Le Bourget Airport.

MAJ. WILLIAM R. PAYNE, Talihina, Okla., pilot on the record-breaking flight of May 26, greets the crowd upon his arrival. Other members of the crew were Capt. William L. Polhemus, Mason N. H. and Capt. Raymond R. Wagener, Horicon, Wis.

Paris Air Show

TOASTING the success of their record-breaking mission, members of the crew raise their glasses with Maurice Guilbot, directeur de l'union Syndicale des Industries Aeronautiques and A. S. Wichel (A), B-58 program manager, General Dynamics-Ft. Worth, with Gen. Leon W. Johnson joining them.

CREW OF B-58 is shown below as it received the Bleriot speed trophy for its record-breaking flight of 30 min. 43 sec. over a closed circuit 669.438-mi. course to establish a new record of 1,302.07 mph. 1st Lt. David F. Dickerson, defensive systems operator, Ardmore, Okla., shown at right of Madame Bleriot, Major Elmer E. Murphy, pilot, Poseyville, Ind., and Major Eugene F. Moses, navigator, Altoona, Pa., stand in front of the trophy along with C. R. MacBride, General Dynamics (A) and N. E. Firestone, GE's Flight Propulsion Div. (B). This is the crew that was killed when its B-58 crashed about 6 mi. northeast of Le Bourget Airport, after making its lone high-speed pass over the show.

SPACE . . . IMAGINATION . . . ENERGY

HERE'S HOW WE MEASURE MISSILE MUSCLE

This is one of the test-bays at the Hercules-owned-and-operated plant at Bacchus, Utah. Here the third-stage engine for the Minuteman rocket was developed and is manufactured for the Air Force. The advanced second-stage Polaris engine, developed for the Navy at Allegany Ballistics Laboratory, is also being manufactured here. Hercules' Bacchus plant is a fully integrated facility for research, development, and production line manufacture of high-specific-impulse solid-fueled rocket engines.

As each new design-idea is proved out in roaring flame, a net of cunningly placed transducers take the engine's pulse, its temperatures, check its pressures, stresses and thrusts. This welter of information is fed, at 20,000 bits

per second over 240 separate input channels, to a central data acquisition room where it is permanently recorded on synchronized magnetic tapes. Meanwhile, as many as twelve high-speed cameras exposing up to 3,000 frames a second on a quarter-mile of film, keep a visual record of everything that happens with thousandths-of-a-second accuracy.

Thus, each test of component, propulsion unit, experimental design or completed engine yields a maximum amount of information ready for computer analysis and integration to advance both design criteria and manufacturing methodology. This is just another example of Hercules imagination in propulsion engineering.

Chemical Propulsion Division

HERCULES POWDER COMPANY
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Hercules Tower, 910 Market Street
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XP61-2

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many who may find it useful to review fundamentals from time to time.

Steel *for Strength . . . Economy . . . Versatility*

Tests for Determining Mechanical Properties of Alloy Steels

The types of tests used to evaluate the mechanical properties of an alloy steel depend upon the end use of the steel involved. Mechanical properties are determined usually by tension, bend, and hardness tests, and by a group of special tests employed on tubular and wire products.

(1) *Tension tests* provide means of determining tensile strength, yield point, yield strength, proof stress, proportional limit, per cent elongation, and per cent reduction of area. This sort of test subjects the steel to stresses resulting from the application of an axial tensile load to the specimen ends, the load being sufficient to rupture the specimen.

(2) *Bend tests* often aid in determining the ductility of steel. The severity of such a test depends largely upon the bending radius used. Several factors influence the length of radius, including thickness of the test specimen, width of test specimen, direction of test, chemical composition, tensile strength of specimen, etc.

(3) *Hardness tests* determine the steel's resistance to penetration. This characteristic is most commonly measured by the Brinell Test or the Rockwell Test. In the former, pressure is applied to the surface of a test specimen by means of a ball 10 mm in diameter. Two diameters of the resulting impression are measured and averaged; the average is converted to the hardness number by means of a conversion table. In the Rockwell Test, the degree of hardness is read on a gage; hardness is measured by the penetration of a diamond point or a 1/16-in. steel ball. Rockwell "C" scale readings are used in connection with the diamond point; "B" scale in connection with the steel ball. The "C" and "B" are the most commonly used of the several Rockwell scales.

(4) *Special additional tests* are often made on tubular and wire products. These include such items as hydrostatic and manipulating tests, and torsion and wrapping tests, the latter two being used only with wire.

The subject of testing and its relationships to the end uses of alloy steels has been given broad study by Bethlehem metallurgists. If you desire, they will be glad to discuss any phase of it with you, and also give unbiased opinions on such matters as analysis, proper selection of steels, machinability, etc. Call for their services at any time.

And when you need alloy steels, remember that Bethlehem furnishes the entire range of AISI standard analyses, as well as special-analysis steels and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

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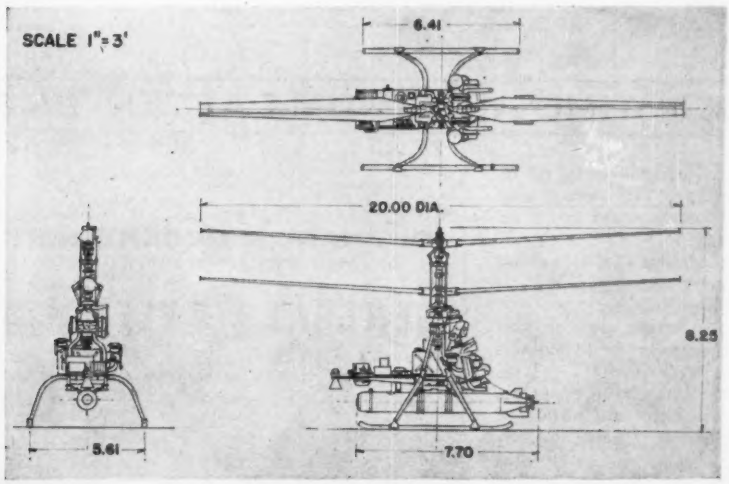
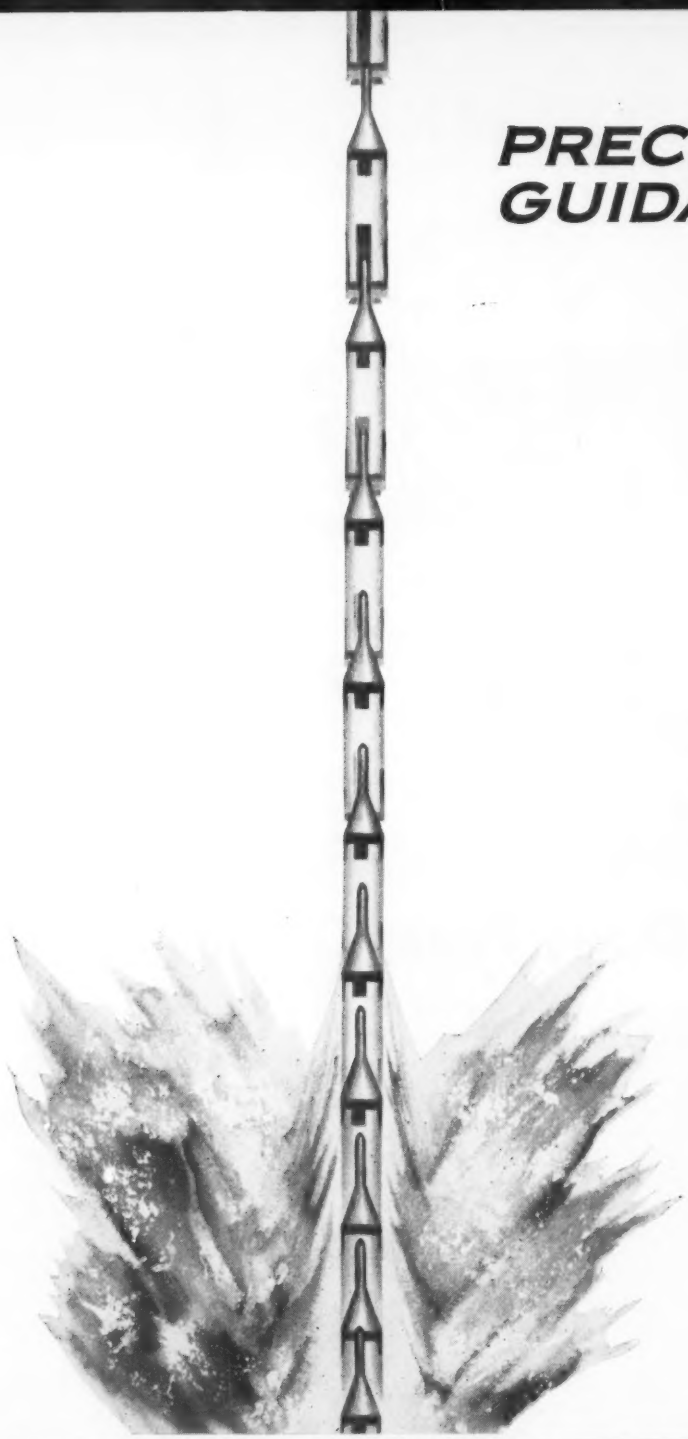
Gyrodyne Drone Passes Operational Sea Trials

Launch, recovery and guidance of the Gyrodyne DSN-1 DASH (drone anti-submarine helicopter) weapon system were proven during operational test and evaluation trials aboard the USS Hazelwood (DD531) off Key West, Fla. Sea trials, conducted in March by the Navy's OPTEVFOR (Operational Test and Evaluation Force), employed the piston-engine DSN-1 to demonstrate the potential of Gyrodyne's turbine-powered DSN-3, now under production. The DSN-3, powered by the Boeing T50-BO-4 270-hp. turbine, will be remotely controlled to drop homing torpedoes on submarines. Tactically, the drone will remain on the destroyer flight deck until sonar information establishes the bearing and distance of a submarine contact. The drone will then be launched and, employing a radar/sonar guidance system, guided into position to drop a homing torpedo. The DSN-1 drone (AW May 29, p. 29) is a two-bladed, coaxial helicopter powered by a 72-hp. Porsche air-cooled automotive engine. Rotor-tip directional controls are incorporated on the 20-ft. blades. Improved power-to-weight ratio of the turbine-powered DSN-3 should enable the drone to carry a much greater ordnance load, permitting attacks on more than one submarine on a single flight. Destroyers compatible with the DASH weapon delivery system are being modified under the Navy's FRAM (fleet rehabilitation and modernization) program. FRAM modifications for the DASH weapon include a flight deck aft of the destroyer's stacks, a hangar housing two DASH drones plus spares and electronic guidance equipment. During periods of heavy weather the drones will lower a cable which will permit the helicopter, under positive lift, to be winched to the destroyer's pitching deck. Key West trials did not use winch recovery.



PRECISION GUIDANCE



POLARIS "ON COURSE"—TIME AFTER TIME AFTER TIME

Over 40 Polaris missiles—with completely operating inertial guidance systems designed by Massachusetts Institute of Technology and produced by General Electric—have been flight tested from land, on the sea, and under the sea.

The repeatedly precise, reliable performance of this MK 1 Inertial Guidance system now is being applied to the advanced MK 2 Polaris Inertial Guidance system by M.I.T., G.E. and Raytheon.

This new, advanced guidance system will be much lighter and more accurate, and will help lengthen the striking power of Polaris from 1200 to 2500 miles.

Polaris Inertial Guidance is typical of the many precision products —antennas, fire control, inertial guidance, launching and handling equipment, torpedoes—being produced by General Electric's Ordnance Department. 166-21

ORDNANCE DEPARTMENT
OF THE DEFENSE ELECTRONICS DIVISION

GENERAL ELECTRIC

100 PLASTICS AVENUE, PITTSFIELD, MASSACHUSETTS

RESEARCH, DESIGN, AND PRODUCTION OF PRECISION ORDNANCE EQUIPMENT—SINCE 1941

Aerospace Industry Profits—1958-1960

Aerospace companies in many cases have more than shared in a general decline in industrial profits, but a compilation of financial reports for the last three years in the accompanying table shows anything but uniformity.

Marked differences in the performances of individual companies have been the rule. There is a splatter of red ink because of write-offs on commercial turbine transport programs. Avionic companies, on the other hand, graphically denote how changing technology has affected profits and sales.

The companies tabulated are only a fraction of those wholly or partly involved in aerospace business in which avionics is an increasingly important segment. Enough are listed to show a representative cross section of various segments of the industry.

Figures compiled in the Securities and Exchange Commission-Federal Trade Commission Quarterly Report show profits for the aerospace industry of $184 million in 1960 on sales of $12,975 million. Profit margin on sales in this tabulation averaged 1.42% and on net worth 7.37%.

Figures in the accompanying table indicate $13 billion is a conservative estimate for the size of the aerospace market. Using only military shares of companies such as General Electric and Minneapolis-Honeywell, the total sales figure for this list alone is nearer $17 billion.

The First National City Bank of New York, in its tabulation, estimated industry profits at $138 million in 1960 compared with $193 million the year before. The 1960 figures represent a profit margin on sales of 1.2% compared with the year before and 6.1% on net worth compared with 9% in 1959.

In the bank's 1960 profit margin tabulation for manufacturing industries, only three industries had lower margins than the aerospace industry. The bank commented:

"In manufacturing, which normally accounts for over half of corporate net earnings, almost two out of three firms reported gains in sales, but only nine in 20 had higher earnings. The much discussed profit squeeze shows up most emphatically in the predominance of declines in earnings per dollar of sales and invested capital, reflecting rising cost pressures under competitive market conditions that forestalled corresponding price advances."

	SALES (In millions)			EARNINGS (In millions)			PROFITS PER SHARE			BACKLOG (In millions)			PROFIT MARGIN SALES %			PROFIT MARGIN NET WORTH		
	1960	1959	1958	1960	1959	1958	1960	1959	1958	1960	1959	1958	1960	1959	1958	1960	1959	1958
AEROSPACE VEHICLES																		
Boeing	1,554.0	1,648.8	1,751.9	24.4	12.7	30.2	3.07	1.60	3.82	2,139.0	2,018.0	2,479.0	1.57	0.77	1.72	10	5.8	14.2
Douglas	1,174.0	883.8	1,209.9	(19.4)	(38.8)	16.8	(5.09)	(8.86)	4.41	1,030.1	1,317.2	1,543.7	(1.65)	(3.83)	1.39	(16)	(24.5)	9.5
Chance Vought	213.8	254.6	333.1	3.8	4.8	8.9	3.27	4.12	7.55	201.0	253.0	370.0	1.8	1.9	2.7	8	10.5	20.4
Fairchild	85.0	114.0	148.0	(5.9)	1.5	(17.4)	(1.97)	.50	(5.74)	43.0	76.0	135	(7)	1.3	(11)	(38)	7	(87)
General Dynamics	1,987.7	1,811.8	1,626.0	(27.0)	31.0	48.3	(2.71)	3.12		2,550.0	2,555.0	2,095.0	(1.3)	1.7	2.95	(9.4)	9.4	15.2
Grumman	325.5	288.9	225.0	7.1	4.9	2.4	3.268	2.243	1.132	327.5	260.0	175.0	2.21	1.70	1.11	13.2	9.9	5.1
Kaman	54.5	34.7	21.4	0.7	0.5	0.5	1.63	1.50	1.38				1.3	1.7	2.4	13.6	15	15.6
Lockheed	1,332.2	1,304.2	974.6	(42.9)	8.7	18.8	(5.82)	1.21	2.86	1,221.3	1,155.1	1,166.1	(3.2)	.7	1.9	(42)	6	13.6
Ling-Temco	148.4	148.7		3.0	3.0		1.25	1.22		100.0			2.0	2.0		10.5	12.4	
Martin	651.2	523.7	483.6	16.8	13.3	11.7	5.43	4.34	3.82	1,026.7	900.5	831.5	2.6	2.5	2.4	18	17	16.8
McDonnell[1]	436.9	435.8	442.4	12.0	10.0	10.0	3.55	2.94	2.93	365.0	541.5	505.7	2.77	2.30	2.27	19	18.8	22.2
North American[1]	964.0	1,044.8	904.0	23.3	30.7	26.7	2.87	3.80	3.34	873.0	662.0	513.0	2.4	2.95	2.95	11	15	14.5
Northrop[1]	233.6	262.8	274.0	7.7	7.3		4.22	4.01	4.31	309.0	204.0	254.0	3.3	2.79	2.6	15	16	19
Republic	215.2	198.0	218.5	4.7	3.4	5.1	3.20	2.37	3.48	637.0	511.0	408.0	2.2	1.7	2.3	8.3	6.4	9.9
Ryan	122.7	84.7	73.7	2.8	2.8	2.2	1.76	1.72	1.70	100.0	145.0	129.0	2.3	3.3	3.1	11.0	11.8	15.6
BUSINESS FLYING																		
Beech	98.8	89.5	95.8	4.8	3.9	3.3	5.41	4.51	3.84				4.9	4.4	3.5	16	15.0	14.4
Cessna	103.2	105.7	95.8	7.2	7.9	5.1	2.24	2.47	1.61	23.7[2]	33.6[2]	45.1[2]	7.0	7.5	5.3	19	24	19.4
Piper	40.2	34.2	27.1	3.5	2.7	2.1	3.80	3.00	2.36				8.5	8.1	8.0	18	26	24.6
AVIONICS																		
Arma	125.4	119.9	115.8	1.0	3.5	4.7	.51	1.83	2.50	109			.8	2.9	4.1	3.6	12.4	17.5
Bendix	792.2	689.6	623.7	26.1	27.4	21.1	4.88	5.11	3.98	452	511	465	3.3	4.0	3.4	10.8	12.0	10.0
Burroughs	389.2	359.7	294.0	9.2	7.1	6.4	1.39	1.07	1.02				2.4	1.9	2.1	7.3	5.8	5.3
Collins Radio	190.8	117.8	107.5	6.5	3.7	1.0	3.04	1.87	.51	190	210	133	3.44	3.16	1.01	15.6	12.6	4.2
General Electric	4,197.5[3]	4,349.5	4,120.8	200.1	280.2	242.9	2.26	3.19	2.78				4.8	6.4	5.9	13.2	19.4	18.5
General Precision	244.4	215.5	168.3	5.3	4.1	0.3	3.46	2.63					2.2	1.9	.18	7.7	6.3	.51
IBM	1,436.0	1,309.7	1,171.7	168.1	145.6	126.1	9.18	7.97	6.93				11.8	11.2	10.8	17	17.2	
Lear	90.9	87.0	63.6	2.8	2.4	1.6	1.03	0.91	0.68	78.0	76.0	71.9	3.1	2.7	2.5	13.4	13.6	11.8
Litton Industries	187.7	125.5	83.1	7.4	4.9	3.7	1.76	1.33	1.04				4.0	3.9	4.4	14.8	14.4	13.2
Minneapolis-Honeywell	426.1[4]	381.4	328.4	26.2	29.3	22.5	3.74	4.20	3.23				6.2	7.7	6.9	13.0	15.7	13.2
Motorola	299.4	291.5	217.8	12.6	14.1	7.3	3.14	3.59	1.00				4.2	4.8	3.4	13.0	17.0	10.2
Raytheon	539.9	494.2	375.1	8.1	10.4	9.4	2.09	3.01	3.08	288.0	300.0	280.0	1.5	2.1	2.5	10.1	14.9	17.2
Texas Instruments	232.7	193.2	91.5	15.4	14.1	6.0	3.91	3.59	1.84				6.7	7.2	6.5	21.5	25.0	23.4
Thompson Ramo Wool, Total	420.4	417.7	340.6	10.1	9.7	8.9	3.13	3.02	2.86				2.4	2.3	2.6	8.4	8.4	8.2
Missiles, space, elec.	195.0	166.7	89.3															
Aircraft	104.7	132.9	163.6															
Western Electric[5]	2,640.8	2,315.3	2,154.7	124.4	102.1	85.9	6.60	5.92	5.17				4.7	4.4	3.9			
Westinghouse	1,955.7	1,910.7	1,895.6	79.0	85.9	74.7	2.22	2.43	2.12				4.0	4.5	3.9	8.2	9.3	8.5
Gen. Telephone & Elec[6]																		
Defense only	138.9	148.8	89.2															
All mfg.	701.2	705.9	572.4	33.6	37.2	32.2							4.8	5.3	5.6			
PROPULSION																		
Aerojet	425.0	364.4	218.3	10.0	8.2	6.0	2.20	1.78	1.36				2.3	2.2	2.7	16.2	15.5	18.6
Avco	322.7	306.0	282.9	10.0	9.5	11.6	.97	.95	1.24				3.1	3.1	4.0	9	9	11.6
Curtiss-Wright	270.5	329.1	388.8	10.0	14.3	25.0	1.15	1.71	5.07				3.7	4.4	6.4	4.9	7	12
Marquardt	65.5	69.0	49.6	1.2	1.3	1.1	.87	.98	.87	39.6			1.8	1.9	2.2	11	14	15
Thiokol	171.5	190.1	88.9	3.5	5.5	3.0	.76	1.20	.71				2.1	2.9	3.4	12	22	16
United Aircraft	987.8	1,080.9	1,200.4	13.8	28.6	42.2	1.95	4.25	6.40	1,150.0	1,000.0	1,400.0	1.4	2.6	3.5	4.8	9.9	15.2

Footnotes
[1] Fiscal years.
[2] Military only.
[3] Defense sales approx. 22% 1960.
[4] Military sales 32% in 1960.
[5] Military and space sales approx. 27% or $724 million in 1960; $682 million in 1959.
[6] Telephone subsidiaries not included.

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Ling-Temco and Chance Vought Work Out Details of Merger

Dallas, Tex.—Chance Vought Corp. will be re-established as a subsidiary of Ling Temco Vought, Inc., if its assets and properties are sold to Ling-Temco Electronics, Inc.

An over-all plan, approved by managements of both companies, provides for exchange of shares of stock for debentures and warrants, other than the shares held by Ling-Temco Electronics, Inc. Each share of Vought stock would be exchanged for $43.50 principal amount of a new 5½% convertible debenture, plus a five-year warrant to buy one-fifth of a share of Ling Temco Vought, Inc., stock at $30 per share.

The debentures would be convertible into common stock of LTV on the basis of one and one-fourth shares of stock for each debenture for a period of five years and one and one-tenth shares thereafter. There are about 1,250,000 shares of Chance Vought stock outstanding, with approximately 39% held by Ling-Temco Electronics, its officers and directors.

If the proposal is approved by the holders of at least 66⅔% of Vought common stock, the effective closing date is Aug. 31. The affirmative vote of at least a majority of the outstanding common stock and 4½% Series A preferred stock will be needed for adoption of amendments to the certificate of incorporation of Ling-Temco, including the change in the company's name.

Proxy statements and notice of shareholders' meetings, to be held June 30, have been mailed to stockholders of both companies.

Concerning the federal tax status of the exchange, Chance Vought's counsel has the opinion that the exchange by each stockholder of the company of his common for LTE debentures and warrants will be a taxable transaction and recognizable gain or loss will be realized for federal income tax purposes upon such exchange by each holder of Vought common to the extent of the difference between the fair market value of the Ling-Temco debentures and warrants received and his cost or other applicable basis in the Vought common stock surrendered in exchange. A ruling has been requested from the Internal Revenue Service to the effect that any gain or loss realized by any holder of Vought common will be capital gain or loss, provided such stock is a capital asset in the hands of the holder.

The debentures will be in fully registered form without coupons in denominations of $100, $500, $1,000 and any multiple of $1,000. They will bear interest at the rate of 5½% per year, payable semi-annually and will be convertible at their principal amount into common stock of Ling Temco Vought up to and including the maturity date, Sept. 1, 1976, at $34.80 per share if converted on or prior to Aug. 31, 1966, and thereafter at a conversion price of $39.54.

Ling Temco Vought officers will be Robert McCulloch, board chairman and chief executive officer; James J. Ling, chairman of the executive committee; Gifford K. Johnson, president; Clyde Skeen, executive vice president; Raymond C. Blaylock, vice president-technical director; Lee D. Webster, vice president-secretary-treasurer, and James J. Kerley, vice president-controller.

The board of the new company will consist of McCulloch, Ling, Johnson, Skeen, Blaylock, W. P. Thayer, Webster, D. H. Byrd of D. H. Byrd Enterprises, Dr. V. A. Davidson, Dr. Levan Griffis of Rice University, Robert B. Gilmore of de Golyer & MacNaughton, E. J. Morehouse of Harriman, Ripley & Co., William H. Osborn, Jr., of Lehman Brothers, Troy V. Post, of American Life Insurance Co., L. T. Potter of Lone Star Gas Co., James O. Weldon of Continental Electronics Manufacturing Co., and W. C. Windsor, Jr., Windsor Properties. Eight of the directors were nominated by Chance Vought, eight by Ling-Temco and one by both firms.

The new company would employ a total of more than 20,000 persons and a combined balance sheet would show total assets of $194,461,130 as of Dec. 31, 1960. Combined earnings for 1960 were $362,332,243 and net earnings were $5,872,229. Total backlog at year-end was $305 million. Ling Temco Vought, Inc., earnings for 1961 will include earnings of Chance Vought only for Aug. 31-Dec. 31, 1961 period.

Collins to Skip Dividend Because of Low Earnings

Collins Radio Co., Cedar Rapids, Iowa, will not pay a dividend for the current fiscal year, noting that although sales for the 12 months ending July 31, 1961, are expected to be up to 10% higher than the record $190 million of 1960, earnings for the current fiscal year will not be significantly greater than the $2.6 million earned in the first six months. Unusually large increase in product development expenses and narrowed margins in government business are the principal reasons given for the decline in earnings for the second half.

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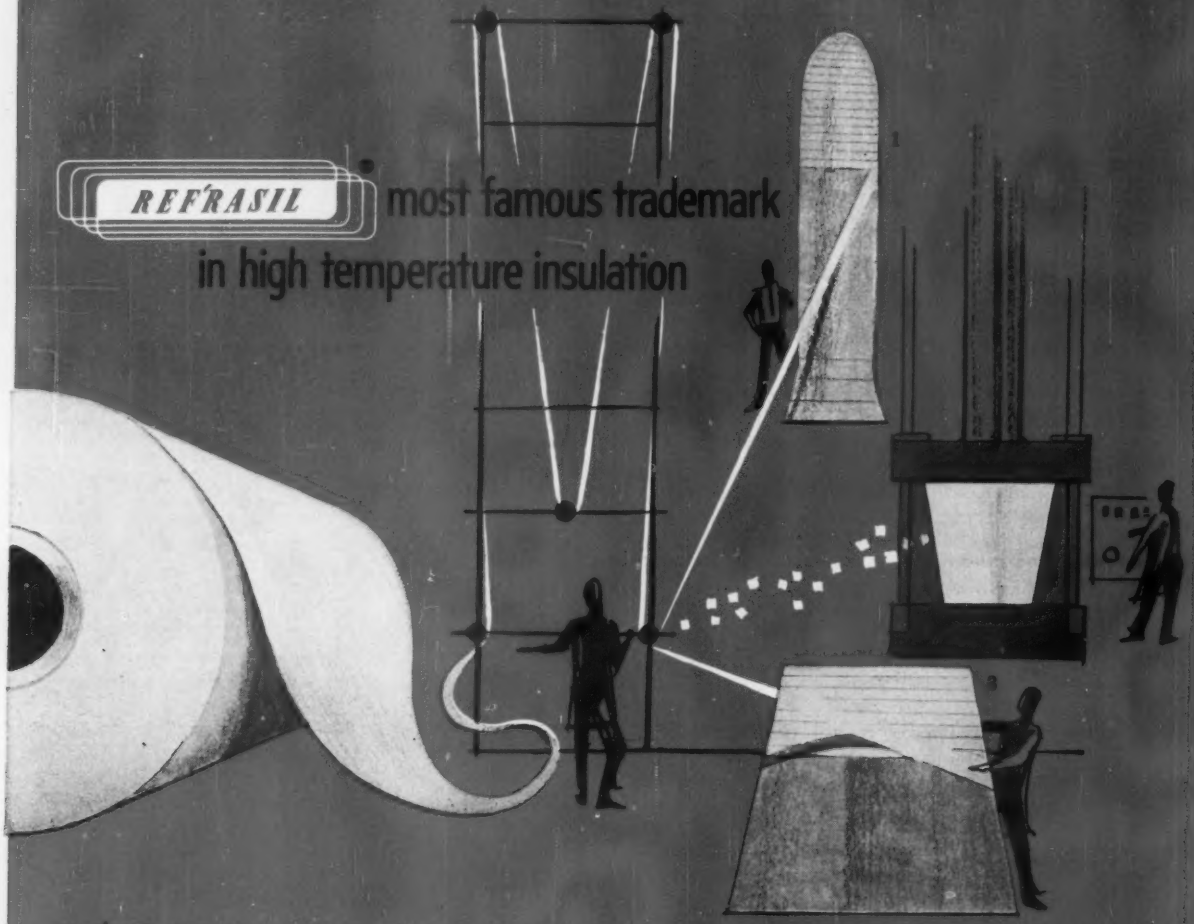

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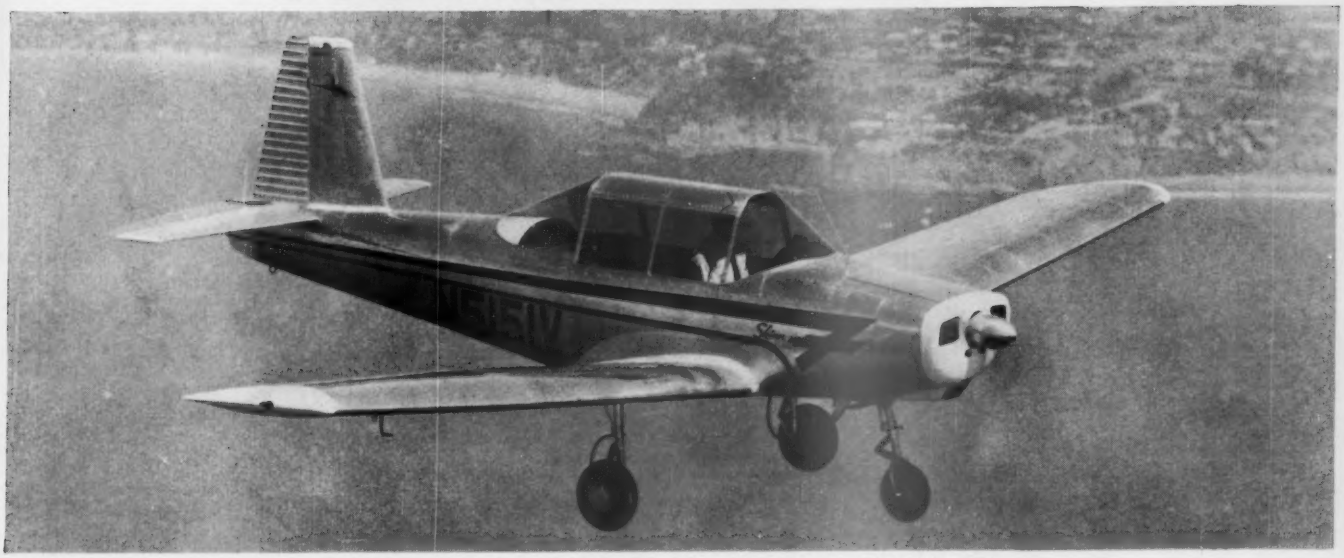

GROSS WEIGHT of Shinn 2150-A is 1,870 lb., top speed of aircraft is 148 mph. and cruising speed is 135 mph.

Aviation Week Pilot Report:

Ease of Takeoff Cited in Shinn 2150-A

By William S. Reed

Santa Ana, Calif.—Good performance and handling qualities combined in a ruggedly-constructed airframe are the main features of the Shinn 2150-A, priced at $8,950.

During a recent flight by this AVIATION WEEK pilot, the two-place, all-metal aircraft exhibited many qualities usually found only in more expensive lightplanes and met or exceeded performance and handling figures quoted by the builder, Shinn Engineering Co.

Takeoff performance of the 2150-A is above average for an aircraft in its category. Fully loaded and with a 5-kt. headwind component, ground roll from Orange County Airport (elev. 54 ft.) was less than 200 ft. By holding the airspeed at 70 mph. with full throttle, the Shinn climbed to 700 ft. by the time the far end of the 4,850-ft. runway was reached.

Landings are similarly short. Performance figures indicate that takeoff distance over a 50-ft. obstacle is 440 ft. and landing distance over a similar obstacle is 450 ft.

Steering on the ground is accomplished through a mechanical linkage between the rudder pedals and the nose gear. Differential, toe-operated hydraulic brakes also are provided. Despite considerable torque developed by the 150-hp. Lycoming O-320-A2B, there is no objectionable rudder feed-in necessary when the nose gear breaks ground on takeoff.

Controllability in flight is very good. The aircraft can be flown in a stalled condition both power-on and power-off. Sufficient elevator power is available to keep the aircraft in a stall and aileron and rudder remain effective after the wing root has stalled. Although not a practical maneuver, flight in the post-stall airspeed region is possible, which demonstrates the controllability of the machine. There seemed to be no tendency for the aircraft to fall off on either wing unless deliberately forced to do so. An unintentional spin therefore, would be very unlikely.

Stall warning, although occurring in sufficient time to give warning, is not of a magnitude adequate for all conditions so that a stall warning indicator is standard equipment. Consisting of a red light and a warning horn, this device provides ample warning of an impending stall. When the aircraft does stall, the effect is unmistakable. A sharp crack is heard as the wing root quits flying, resulting in a buffeting on the canopy.

Lightness and response of the controls indicate that the 2150-A would make a good aerobatic machine but certification has, as yet, not been obtained for such maneuvers.

Landing characteristics of the air-

SHINN 2150-A features full-view canopy which is certificated to be open in flight.

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ENGINEERS and SCIENTISTS

SATIN is an example of MITRE's pioneering efforts in large control systems. Excellent opportunities are currently available in this program for well-trained engineers, mathematicians, and physicists with active, inquiring minds. If you have an interest in computers, communications, control systems or aircraft and like to put new ideas to work, there may be a place for you in MITRE's expanding Air Traffic Control activities. Openings are also available at MITRE's facility in Montgomery, Alabama.

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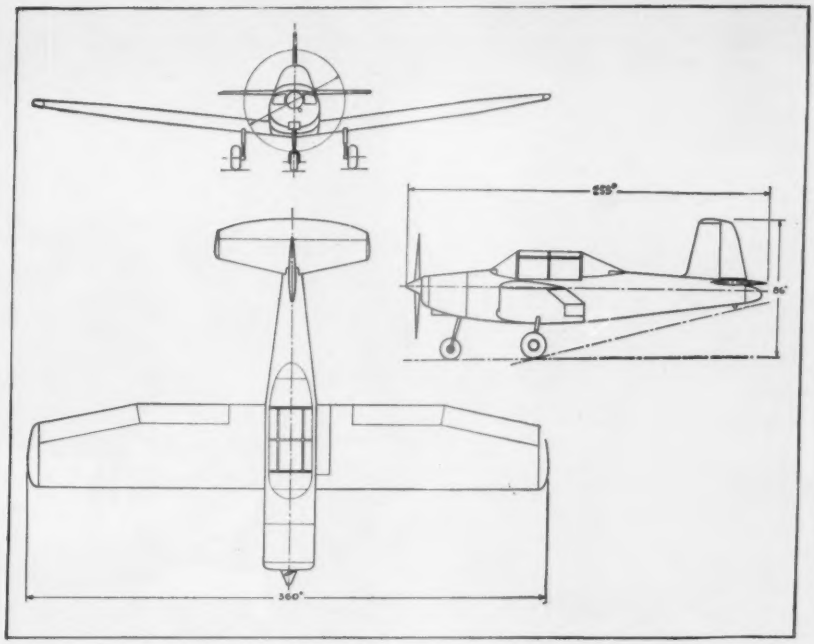
A brochure more fully describing MITRE and its activities is available upon request.

All qualified applicants will receive consideration for employment without regard to Race, Creed, Color or National Origin.

2150-A Specifications

Engine	Lycoming O-320-A2B
Hp. and rpm	150 @ 2,700
Gross weight—Normal category	1,817 lb.
Utility category	1,570 lb.
Empty weight	1,125 lb.
Useful load	692 lb.
Wing span	30 ft.
Wing area	144 sq. ft.
Length	21.2 ft.
Height	7 ft.
Propeller diameter (max.)	74 in.
Power loading (lb./hp.)	12.12
Wing loading (lb./sq. ft.)	12.5
Fuel capacity	35 gal.
Maximum speed	148 mph.
Maximum cruise	135 mph.
Stall speed	52 mph.
Takeoff distance (50-ft. obstacle)	440 ft.
Landing distance (50-ft. obstacle)	450 ft.
Best rate of climb speed	78 mph.
Sea level rate of climb	1,450 fpm.
Fuel consumption	
75% rated power	10 gph.
65% rated power	8.8 gph.
60% rated power	8.2 gph.
Cruising range (stat. mi.)	525



LENGTH of Shinn 2150-A is 21.2 ft. Height is 7 ft., and wing area is 144 sq. ft.

craft are quite straightforward and no special technique is required to effect safe, smooth landings. The approach with flaps down is made at 80 mph. indicated airspeed (IAS), although to execute really short field landings the airspeed can be brought to 70 mph. and a bit of power added.

The flap handle, located in the front cockpit, is beneath the pilot's left leg. When pulled up to extend the flaps, it causes some restriction of movement. The aircraft flown was one of the original 10 aircraft built by Morrisey and the arc of the flap handle has been changed in the production models to eliminate this interference.

The Shinn can be landed in a variety of ways from a full stall to "spiking" it on the runway at 70 mph. Minimum landing speed at touchdown with full flaps is 56 mph. and the nose wheel is sufficiently high off the ground so that landing occurs main gear first. No rudder shock occurs when the nose wheel touches as is the case with some aircraft having the rudder mechanically linked to the nose gear for ground steering.

Visibility from the front seat is good and, even from the rear seat, the aircraft can safely be operated both in flight and on the ground. Although there is no instrument panel in the rear, the rear seat pilot can observe the airspeed and altimeter in the front cockpit. All necessary controls, stick, rudder, brakes, carburetor heat, throttle, with the exception of the flap handle, are duplicated in the rear seat.

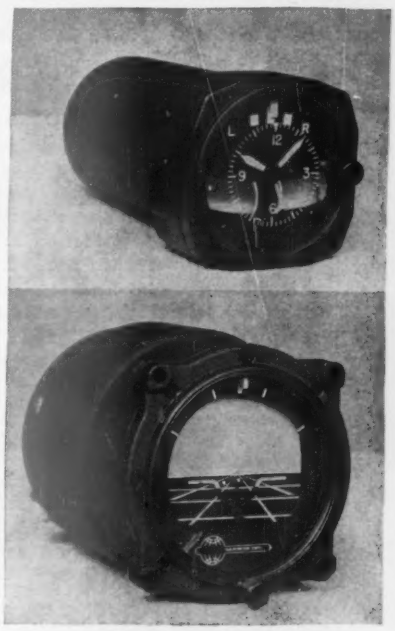
Formal rollout of the first Shinn 2150-A was preceded by an investment of $250,000 in tooling and production facilities including a hand-built prototype. C. L. Shinn, president of the firm, says that first year production is sold out and the facility already is beginning to appear inadequate. Shinn says that without increasing plant capacity, a second shift could be put on to double production but the company is looking for another plant site, probably in a depressed employment area, to supplement present space in Santa Ana.

Shinn has developed Class A tooling for production and according to Vice President R. L. Follett, 19 persons will constitute the full work force on the line. All hydro-formed parts and landing gear are subcontracted, leaving assembly and component installation to be done in the factory. After painting, the aircraft, minus wings, are moved to the Santa Ana-Orange County Airport for final assembly, checkout and production flight testing. More than 1,500 production tools have been developed for the aircraft aimed at low cost, high rate production.

Marketing Operation

Shinn's marketing operation will follow along with the present day trend and eliminate distributorships entirely. Dealerships will be on a factory-direct basis, thereby eliminating the distributor markup, usually pegged at 5%. Follett has a list of dealers who already are established in aircraft sales but who do not have a competitive line. Thus, the financial strain of establishing new dealerships will largely be eliminated.

The Shinn 2150-A will come factory equipped with many extras, available on other aircraft as optional features. Included among these will be an electrical system with starter, generator, navigation and cockpit lights, propeller spinner, sensitive altimeter, recording tachometer and a soundproofed interior.



Bank Indicator

Flight equipment intended to facilitate instrument flying for private pilots include turn and bank indicator mounted on a clock face (top) and a natural sensing attitude gyro (bottom). Equipment is manufactured by Garwin, Inc., 1326 Walnut Street, Wichita, Kan.

...THE CAR POOL

There are no vital statistics but it is obvious from the Grumman experience that many A-1 engineering ideas have been born under the unexpected stimulation of a ride to work. Total involvement seems to be characteristic of the Grumman engineer.

The elastic approach to work and absence of rigid protocol is the norm at Grumman. The engineer moves in the direction his talents take him, whether this be theoretical analysis, translating concepts to finished hardware, equipment development, checking systems compatibility or 'seeing the system through' to laboratory testing.

Engineers who find flexibility necessary for their own 'modus operandi' are cordially urged to consider the following immediate positions.

Digital Computer Systems Engineer—BSEE with a minimum of 4 years experience in the analysis design and development of digital computers. Will participate in the integration of digital computer into a complex weapons system. A significant part of the effort will be devoted to extensive laboratory and flight development programs.

Electronics Support Equipment Engineer—Electronic Engineer experienced with digital computers, radar & communications who welcome an opportunity to utilize their present skills while they extend their technical background to new areas. Will analyze complex weapons systems to establish test logic & techniques involved in a comprehensive automatic test program utilizing ground support equipment. BSEE with a minimum of 3 years experience.

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BS-17A "AIRLINER", under development by Omega Aircraft Corp., has a five-bladed rotor and is powered by three Allison or Boeing turbine engines. Passengers are carried in a detachable pod, readily substituted for cargo configuration.

Omega's BS-12D-1 Helicopter Certified; Other Versions Planned

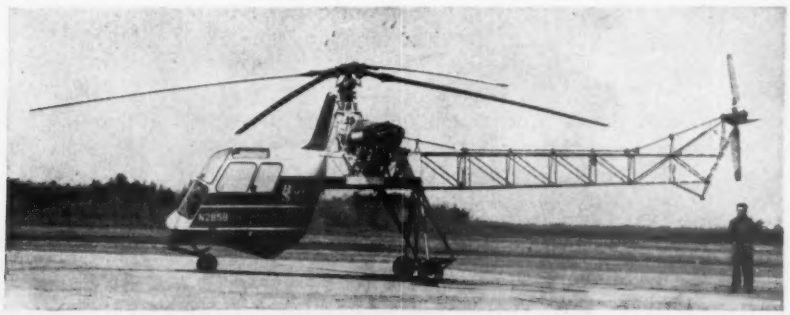
First commercial twin-engine helicopter Certificate of Airworthiness was presented recently by the Federal Aviation Agency to Bernard W. Sznycer, president of Omega Aircraft Corp., New Bedford, Mass., for the company's five-place, twin Lycoming 235-hp. belt-driven BS-12D-1 helicopter.

The original prototype made its first flight in 1956 (AW May 7, 1956, p. 50) with the BS-12 configuration progressing thru A, B and C models until development and certification of the D-1. Maintaining the general "flying crane" configuration (which Sznycer pioncered), the basic changes that were incorporated in the D-1 model include the following:

- **Replacement** of the original 200-hp. Franklin engines with the Lycoming O-540-F1A5.
- **Redesign** of the forward cabin and increasing the window area.
- **Replacement** of the quadricycle landing gear with a tricycle gear.

Progressive plans for the basic BS-12 helicopter, which sells for $77,500, include the development of:

- **BS-12J,** to be powered by two 290-hp. Lycoming IO-540 engines and providing a useful load of 1,695 lb., improved performance at higher altitudes and also an improved single-engine performance.
- **BS-12F,** powered by two Allison T63 or Boeing 502-W turbines. Field conversion from the piston engines, with no effect on the balance of the aircraft, is possible. Production is predicted for mid-1963 or early 1964, according to availability of production quantities of turbine engines. Inasmuch as these engines are of the free turbine type, clutches, belt drives and cooling systems will not be required, resulting in a weight and maintenance saving as well as keeping the original cost on the same level as the piston model.
- **BS-14,** a two-place helicopter powered by either the Lycoming O-540 260-hp. or the IO-540 290-hp. engine and adaptable to the Allison or Boeing turbine. With a top speed of 150 mph. (turbine-powered), 400-lb. payload, this model would be suitable for police, fire and powerline patrol as well as for military service.
- **BS-17A** "Airliner," features a five-bladed rotor, a slightly longer fuselage with a quadricycle landing gear, as well



BS-12D-1, latest version of Omega's BS-12 helicopter, has been certificated by the Federal Aviation Agency. Cabin has been modified, new tricycle gear incorporated in the five-place D-1. Aircraft is powered by two 235-hp. Lycoming O-540-F1A5 engines. Basic aircraft sells for $77,500.

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LOCKHEED CALIFORNIA DIVISION

as three Allison or Boeing turbines. Passengers are carried in a detachable pod which can be substituted for a cargo configuration in a relatively short time.

The basic BS-12 helicopter is suitable for both cargo and passenger operations and is specifically designed to pick up the standard airline pod. Controllability and stability of the aircraft are maintained by placing the cargo pod directly behind the cabin in the external bay within the aircraft's center of gravity. In addition to eliminating in-flight drag this carrying position gives the craft a chance to use the ground cushion effect which provides extra power reserve during takeoff and landing. The "flying crane" configuration makes it especially suitable for carrying unwieldy cargo such as pipes, lumber or other bulky objects in its open cargo bay.

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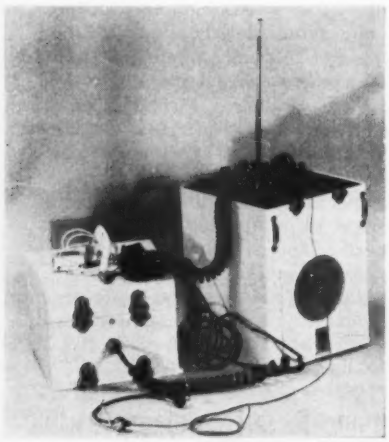
Production schedule of D-1 models calls for 25 aircraft in the first inventory —producing one helicopter a month for the first nine months starting June 1 with production schedule increasing as parts and equipment become available.



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Auxiliary navigation and communications system for business aircraft includes a 90-channel VHF transceiver, 90-channel VHF receiver, omni indicator and loudspeaker. Price of the unit, manufactured by Beech Aircraft Corp., Wichita 1, Kan., is $2,495 for a 14-volt system and $2,595 for the 28-volt unit.

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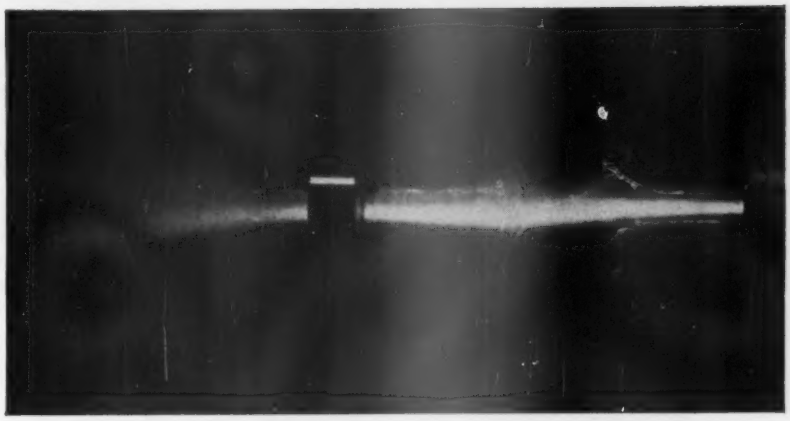

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WHO'S WHERE

(Continued from page 23)

Changes

L. J. Staehle, assistant to the general manager, Lockheed's Missiles and Space Division, Van Nuys, Calif.

Gerald E. Hughes, head of applications engineering, Micromodular Components Division of Ling-Temco Electronics, Inc., Anaheim, Calif.

Capt. Sheldon W. Brown (USN, ret.), manager of Aerojet-General Corp.'s Atlantic Division, Frederick, Md.

George F. Emerich, manager, Solid Propulsion Operations, McGregor, Tex., of Rocketdyne, a division of North American Aviation, Inc.

Allen J. Lovenstein, manager Advent satellite communications program, Waltham Laboratories of Sylvania Electronic Systems, Waltham, Mass.

Dr. Lewellyn T. Boatwright, Jr., director of engineering, Sparton Southwest, Inc., Albuquerque, N. M.

Richard L. Jess, chief-tactical weapons systems requirements, Missiles & Space Systems Department of Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

Robert J. Gilson, general manager, Military Products Division-Rochester, General Dynamics/Electronics, Rochester, N. Y.

Thomas I. Paganelli, manager of the newly established Systems Operation, General Electric Co.'s Heavy Military Electronics Department, Syracuse, N. Y.

George H. Van Houten, safety superintendent, Pan American's Guided Missile Range Division, Cape Canaveral, Fla., and **D. G. Davis,** assistant manager-industrial relations for the division.

Eugene V. Thatcher, manager Atlas project office (Patrick AFB, Fla.) for Flight Test Operations-Space Technology Laboratories.

J. H. Leutwiler, division manager, Sperry Microwave Electronics Co., Clearwater, Fla., a division of Sperry Rand Corp.

Lockheed Missiles and Space Division, Sunnyvale, Calif., has announced the appointment of the following assistant general managers: **S. W. Burris**—Polaris Missile System; **D. J. Gribbon**—Satellite Systems.

Joseph S. Brennan, manager, Electromechanical Engineering Department, Aircraft Armaments, Inc., Cockeysville, Md.

Malcolm H. Barnes, sales manager, Technology Instrument Corp., Acton, Mass.

Ramon San Vicente, chief engineer-glass diodes, International Rectifier Corp., El Segundo, Calif.

Dr. I. H. Swift, director, Information Systems Laboratory, North American Aviation's Space and Information Systems Division, Downey, Calif.

Robert T. Donohue, director, Systems Research Laboratory, Geophysics Corporation of America, Bedford, Mass.

Dr. Daniel C. Schiavone, director of reliability, corporate engineering staff of The Martin Co., Baltimore, Md.

Harold A. Cheilek, associate technical director of Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

Max Lowy, manager of systems integration, Gulton Industries, Inc., Metuchen, N. J.

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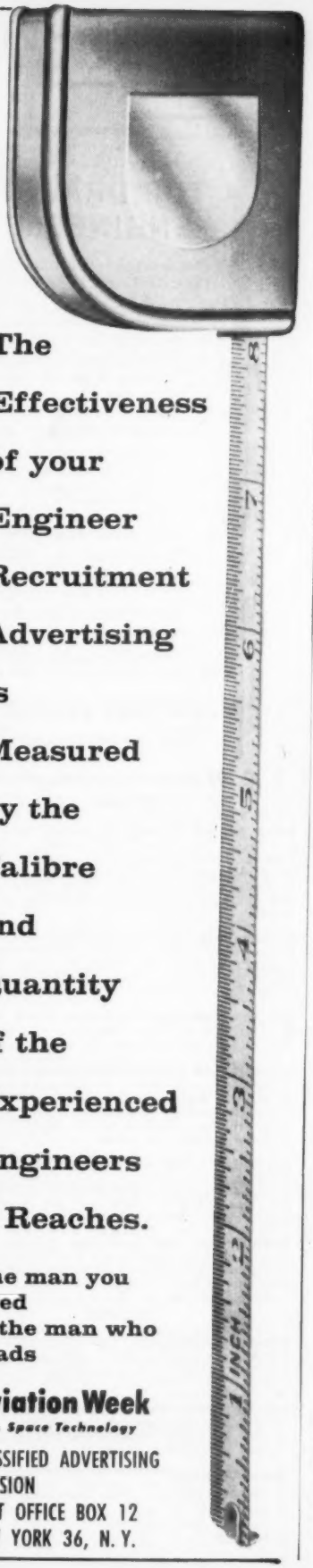

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CHANCE VOUGHT

LETTERS

Glossy Proposals

The eloquent admonitions by the Honorable Joseph V. Charyk and their endorsement by your editor (AW May 29, p. 17) will go unheeded by and large. Not because they are unsound. And not because many responsible in the aerospace industry will disagree.

But as long as glossy proposals get the orders, glossy proposals will be made. The facilities brochures will continue to show the aerial view of the plant, the drill presses, resumes of Ph.D.s and masked people in white gowns if the feeling prevails that this is what is needed to make the sale.

The government procurement agencies and more so the aerospace prime contractors, which do the major procurement for the government, have increased over the years their requirements for proposals submitted to them to an extent that the essential technical, price, and delivery information is dwarfed by a bureaucratic nightmare of substantiating data, procedures, and progress charts of all forms and types. Their alleged purpose is to evaluate the bidder and keep him in line should he get the order, so that he does not make too much money, which everybody in the industry knows is a much greater crime than floundering but being able to prove that you lost money.

The perseverance and ingenuity of the Wright brothers is often invoked by exasperated people in high places. Why can't it be done again? I choose to believe that it can be done and perhaps is being done, allowing for the scope of science and technology of 1961. The answer to why it doesn't happen more often is complex, and could be traced to the attitudes and motivations created by our environment. For the modest point which this letter wishes to make, it would be well to remember that the Wright brothers did not write progress reports and the Spirit of St. Louis was built without bar charts in less time than it takes now to evaluate a proposal for a minor subsystem of a new aircraft.

There are a number of constructive steps government procurement agencies could do and cause to be done at the major aerospace prime contractors. Technical proposals can be requested to be limited in size. Price and delivery can be stated essentially in the same terms as it is done in commercial practice. A need-to-know should be established for the buyer to request information beyond that. Procurement clauses, administrative specifications with their multiple revisions and addenda should be reviewed to determine whether they are really needed. Let there be a contest among buyers who can come up with the least in this respect.

Above all, build up confidence among the sellers that those with a sound technical proposal, a low price and the basic wherewithal to execute it will get the order, even though the proposal was not printed and bound and the plant is located on the other side of the tracks.

H. W. KRETSCH
Vice President-Chief Engineer
Consolidated Controls Corp.
Bethel, Conn.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Test Pilots

In the April 17 issue of AVIATION WEEK (p. 31), in an article entitled "Industry Fights New USAF Test Policies," it was stated that the Society of Experimental Test Pilots objects to any encroachment into the area of work done by contractor-employed test pilots. This statement is incorrect.

No doubt individuals within the Society have strong feelings on this issue; however, the constitution of the Society prohibits us as a body from voicing an opinion on a political issue such as this one. In addition, the Society membership is composed of approximately 50% military test pilots and 50% contractor test pilots. Obviously, the Society would not take sides against itself. For these reasons the Society of Experimental Test Pilots has not or will not voice an opinion on the subject of your article.

A. S. WHITE
President
The Society of Experimental Test Pilots
Lancaster, Calif.

Elastic Prices

I see in the May 1 number of AVIATION WEEK, in the insert "Facts and Figures about Air Transportation," that the airlines still believe an increase in fares will increase their income and profits. Has no one ever told them about price elasticity? Have they never read "My Life and Work" by Henry Ford?

By comparing the figures for "Average Revenue per Passenger Mile" with the traffic growth figures for recent years it is easy to show that a price elasticity index of about —2 corresponds well with the reduction in traffic growth which occurred. In other words, the traffic volume is reduced in percentage about twice as much as the fares increase and a reduction in revenue is the result.

Some people blame the poor traffic growth on the recession. However, traffic on the North Atlantic has been booming in spite of the recession, and the reason is the reduction in average fares due to the increasing popularity of the economy class.

In a time of excess capacity it seems folly to increase fares, especially when the cost of auto travel is not going up at all.

It is about time to reduce fares instead of increasing them, so that the air traffic forecasts made a few years back will not look so very optimistic as they do at the moment.

In my opinion, it is not the forecasters who made the mistake, it is the fare policymakers.

FRED TURNER
Hackefors, Sweden

Space Fantasy

Rep. Victor Anfuso's "Star of Hope" satellite (AW May 29, p. 21) seems a bit mild. Why not carry the spirit of the concept a little further and put all of the Macy's Thanksgiving Day Parade balloons in orbit, at say $15 billion? Perhaps Walt Disney could be brought in on the project and then we could do something really bold and imaginative. I'm sure the people of underdeveloped lands would be more impressed with a 5,000 ft. Mickey Mouse in orbit than they would with a Christian Star of Bethlehem.

WILLIAM WEATHERED
Fairfield, Conn.

Space for Peace

Dr. Jerome B. Wiesner's studies which were published in the Jan. 23 issue of Aviation Week (p. 79) were quite impressive. From his research I would gather there is a growing interest in space research and less interest in military space vehicles. He credits this to man's innate desire for exploration and study of the unknown.

This all brings me to the point of my letter. It seems to me that we are missing one of the best opportunities we have had in solving our problem for world peace. Every article on the missile gap, disarmament, etc., only tends to focus too much attention on our differences in the world.

One of the oldest tricks to get someone's mind off a sore point is to divert his interest. It's done with children every day and has worked most every time—if a child wants to do something dangerous or injurious to himself you don't focus his attention on it but rather you dig up something more interesting to divert his attention and the problem has solved itself.

What I'm trying to say is that the people of the world are more interested in a Sputnik or a Discoverer than an Atlas ICBM any day. Ask yourself why. If we could foster this interest in peaceful space exploration instead of always worrying about who is going to own it when we get there, or who can blow up whom better, we would be more worthy of the name adult.

Through the U. N. we, the United States, ought to be leading the way by putting a token amount of money at the disposal of this group along with scientists to be used in the peaceful conquering of space. We would then ask other nations to follow suit.

If this could be done, I'd be willing to wager that we would soon be soft pedaling armaments, atomic bombs, and ICBM potentials.

At this late hour anything is worth a try, but we have to try.

I know I'm fed up with this overdone sword sharpening contest, and I hope to read more about space accomplishments in the interest of all mankind and less about who's going to throw who's gun away first.

FRANCIS J. MULLER
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